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Reactions to Anesthetic Solutions—*Miller*
Mandible and Postnatal Development—*Dunn*
Management of Soft Tissues—*Sorensen*
Edentulous Mouth and Infection—*Sweet*
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Does Our Code of Ethics Mean Anything?
Changing Concept of Oral Focal Infection

ASSOCIATION ACTIVITIES

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DENTAL ECONOMICS

COUNCIL ON DENTAL THERAPEUTICS

FIFTY CENTS

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WILLIAM H. G. LOGAN
President of the International Dental Federation

THE JOURNAL *of the*
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CLINICAL REACTIONS TO VARIOUS ANESTHETIC SOLUTIONS*

By HOWARD C. MILLER, D.D.S., F.A.C.D., Chicago, Ill.

THE study herein referred to, consisting of a survey of data accumulated after many operative procedures in cases requiring surgical measures, such as the removal of teeth, was conducted by Carroll W. Stuart, Paul G. Dick and myself. The investigation was undertaken in an effort to secure accurate data on comparative reactions of a group of patients after the injection of such procaine solutions as are routinely used in the practice of oral surgery and general dentistry. A preliminary report was made at the Midwinter Clinic of the Chicago Dental Society in February 1936, it being felt that the tabulation of results to date had a distinct value in demonstrating the clinical reaction of the patient to procaine in combination with epinephrine in various concentrations and cobefrin hydrochloride.

The addition of a vasoconstrictor in some form is necessary in the use of local anesthetic agents available at the present time, in order to prolong anesthesia and to lessen the tendency to toxic reactions, due to too rapid absorption of the injected solution. Epinephrine has been studied extensively in its wide clinical application as the vasoconstricting agent in combination with procaine. In more recent years, other compounds have been given clinical trial for use as vasoconstrictors in connection with local anesthetic solutions. Among these may be mentioned ephedrine, synephrine, neosynephrine hydrochloride and cobefrin hydrochloride, all of which are more or less related chemically to epinephrine, and have a like pharmacologic action.

The toxic symptoms produced by the use of epinephrine in combination with procaine are usually manifested by apprehensiveness, tremor, heart consciousness, labored respiration, rapid pulse, pallor, perspiration, occasional signs of nervous instability and syncope. Toxic symptoms resulting from the use of pro-

*Read at the Eighteenth Annual Meeting of the American Society of Oral Surgeons and Exodontists, San Francisco, Calif., July 10-11, 1936.

caine must be differentiated from those arising from the use of epinephrine, in that they develop more slowly, are more persistent and do not recede nearly so rapidly. General depression and a more or less marked fall in blood pressure are notable symptoms. The patient is usually quiet, seldom restless. The respiration is shallow and irregular, the skin is cold and clammy and the eyes are dull and expressionless. Nausea and vomiting may occur. The patient may be conscious or bordering on a state of unconsciousness. In extreme intoxication, he may become totally unconscious and pass into coma, with cessation of respiration and death.

There are of course certain facts which must always be taken into account in the prevention of unfavorable reactions from the use of any anesthetic agent. Obviously, the patient's physical condition must receive full consideration. Preoperative and postoperative care, as well as operating technic and environment, have all been stressed elsewhere, and it is unnecessary to discuss here the nervous or susceptible type of patient who requires particularly discriminating attention, and with whom we are all familiar. Suffice it to say that, in this survey, our procedure throughout was uniform, especially with reference to the amount of solution injected and the technic followed in blocking the various branches of the fifth nerve.

The preliminary study was concerned with the reaction of the patient to the use of procaine in combination with epinephrine and cobefrin hydrochloride during 300 operative sessions on ninety-six patients. The solutions used were 2 per cent procaine with 1:20,000 epinephrine; 2 per cent procaine with 1:50,000 epinephrine, and 2 per cent procaine with 1:10,000 cobefrin hydrochloride.

Because it has been said that the unfavorable reactions that sometimes follow injection of a local anesthetic solution are entirely psychic and are not due to injection of the solution, Ringer's solution was injected as a control in twenty-one cases.

The study to date covers a survey of

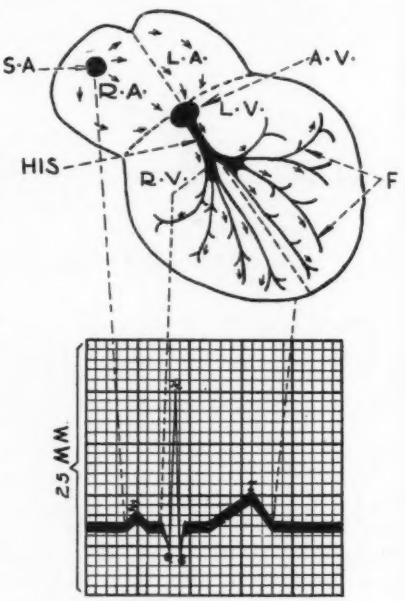

Fig. 1.—Relationship of electrocardiogram to anatomic elements of heart. The impulse to contraction arises in the sino-auricular node within the right auricle. The passage of this stimulus through the right and left auricles gives rise to the first deflection of the electrocardiogram known as the P-wave. A slight delay occurs at the auriculoventricular node and the impulse passes into the ventricles. The deflections labeled Q, R, S and T represent passage of the impulse through the ventricular portion of the heart; *SA*, sino-auricular node; *HIS*, bundle of His; *AV*, auriculoventricular node; *F*, fibers of Purkinje.

398 operative sessions on 148 patients. In addition to the three anesthetic solutions and the Ringer's solution control

mentioned above, we have used 2 per cent procaine with 1:25,000 epinephrine; 2 per cent procaine with 1:75,000 epinephrine; 2 per cent procaine with 1:100,000 epinephrine, and 2 per cent procaine borate with 1:31,250 epinephrine. A record was kept as to the type, percentage, and manufacture of the anesthetic solutions used, whether freshly prepared or stock, the date obtained and from what source. The hydrogen-ion concentration of each solution used was noted by means of a stop watch and indicated on the chart. The type of injection, the amount of solution deposited, the general reaction of the patient and the anesthetic results were also recorded. After operation, a test was made for anesthesia at ten-minute intervals to determine as nearly as possible its duration. In addition to this, electrocardiograms were made at fifty-four operative sessions, on twenty-six patients. An electrocardiogram was made before injection,

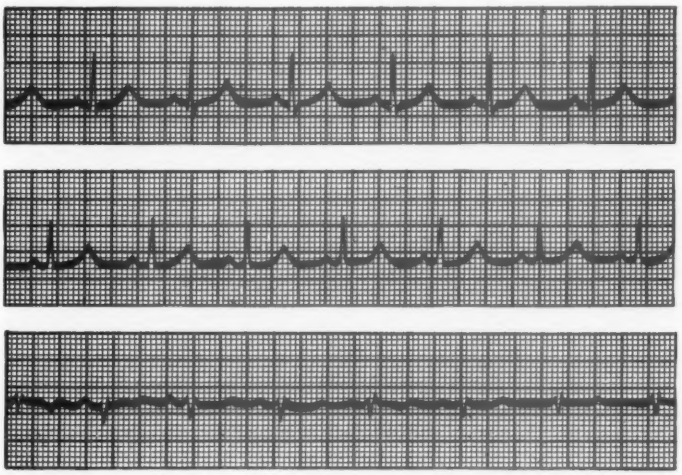

Fig. 2.—Electrocardiogram before injection of Ringer's solution. The rate of the heart is 80. The rhythm is of sinus mechanism. The axis deviation is mildly left. The P-R interval is 0.16 second. The T-wave is upright in leads 1 and 2 and diphasic in 3. (Patient, Miss K. J.; date, April 17, 1936.)

determined by means of the Coleman p_H electrometer.

The routine technic was as follows: Before any procedure was undertaken, the systolic and diastolic blood pressure, pulse and respiration were noted, the readings being repeated throughout the entire session and recorded at two-minute intervals. The time required for injection, induction and operation was after injection and after operation, this procedure giving three recordings for each session, the first of which was used as a control.

The study has not been confined to any one type or manufacture of solution, as purchases were made from various sources. The p_H of the stock solutions used varied from 3.55 to 5.60, none more nearly approaching the neutral. The

freshly prepared solution made from tablets of procaine hydrochloride with epinephrine varied from p_H 4.60 to p_H 6.58. Freshly prepared solutions made from tablets of procaine borate with epinephrine gave a p_H of from 7.6 to 8.18, definitely on the alkaline side. It is therefore evident that an alkaline solution can be obtained only by preparing either a fresh solution of procaine borate or by alkalinizing a solution of procaine hydrochloride with some agent that is nonirritating to the tissues.

this amount of solution was ninety seconds, the same rate of injection being maintained throughout. The total amount of solution deposited at any one operative session varied from 2 to 9 c.c. The period of waiting for complete anesthesia following injection was from one to twelve minutes, complete anesthesia being obtained in a relatively uniform time with all solutions used, regardless of whether they were on the alkaline or on the acid side. The duration of anesthesia ranged from thirty

Fig. 3.—Electrocardiogram after injection of Ringer's solution. (Compare Fig. 2.) There is no change in rate, rhythm or conduction. (Patient, Miss K. J.; date, April 17, 1936.)

No attempt was made to classify patients as far as systemic disturbances were concerned, aside from the usual routine history taking and notation of the general appearance of the patient.

A uniform amount of solution was deposited for each type of injection, the maximum amount being 2 c.c. in cases of blocking the inferior dental lingual nerves. The average time for depositing minutes to one hour and fifty minutes, as far as we were able to determine with a sharp instrument. The degree of anesthesia was graded as profound, fairly good, unsatisfactory or a failure, with the anesthetic result in the majority of cases satisfactory. In a small percentage of cases, it was necessary to reinject before surgical anesthesia could be obtained.

Fig. 4.—Electrocardiogram before injection of procaine 2 per cent with epinephrine 1:20,000. The rate of the heart is 85. The rhythm is normal. The QRS is of normal contour. The T-waves are upright in leads 1 and 2 and blunted in 3. (Patient, Mr. C. D.; date, March 13, 1936.)

Fig. 5.—Electrocardiogram after injection of 2 per cent procaine with 1:20,000 epinephrine. (Compare Fig. 4.) The rate has increased to 98. The rhythm is the same. The QRS complex remains the same, while the T-waves become somewhat blunted in all three leads. (Patient, Mr. C. D.; date, March 13, 1936.)

Postoperative results varied but little, regardless of the type of solution injected. No excessive postoperative discomfort or delayed healing was traceable to the anesthetic solution used.

To report in detail the graphic records of the respiratory and pulse rates and blood pressures on all the case records would be boresome. We therefore present detailed statistics of the fifty-four cases in which electrocardiograms were made and which are definitely representative of all the cases on file.

five waves, P, Q, R, S and T. (Fig. 1.) The first wave, which is associated with the auricular activity, is known as the P-wave. A short pause of less than one-fifth second occurs, and the Q, R and S waves, representing the ventricular activity, follow. The T-wave represents the terminal phase of the electrical phenomenon of the ventricular activity. The straight line following the T-wave indicates the rest period of the heart.

I do not pretend to qualify as an expert in interpreting electrocardiograms.

Fig. 6.—Electrocardiogram before injection of procaine 2 per cent with epinephrine 1:25,000. The rate of the heart is 75. There is a single extrasystole of ventricular origin. The QRS is of normal contour. The T-waves are upright in leads 1 and 2 and blunted in 3. (Patient, Mrs. D.; date, April 24, 1936.)

The electrocardiograph is an instrument which records the minute electrical phenomena of the heart beat. The electrocardiogram is the record made with this instrument by photographing the deflections of a galvanometer which moves with the changes in electrical potential associated with each cardiac cycle. In this record, there is normally a series of

This brief explanation is offered merely to show the deviations from normal in the electrocardiograms following the injection of the different solutions. The following statistics were compiled by Paul G. Dick and Chauncey C. Mahar from the electrocardiograms made in connection with this study.

On the first visit, the objective and

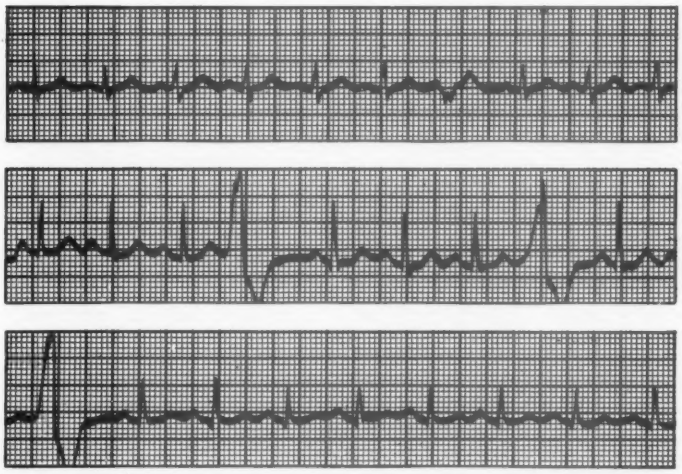

Fig. 7.—Electrocardiogram after injection of procaine 2 per cent with epinephrine 1:25,000. (Compare Fig. 6.) The rate of the heart has increased to 120. The extrasystoles become more numerous and the T-waves are changed in all three leads. (Patient, Mrs. D.; date, April 24, 1936.)

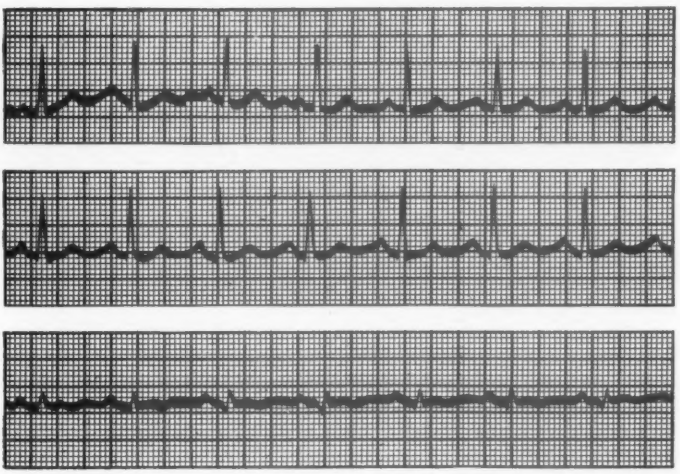

Fig. 8.—Electrocardiogram before injection of procaine 2 per cent with epinephrine 1:50,000. The rate of the heart is 90. The rhythm is normal. The PR interval is 0.18 of a second. The QRS is notched in lead 3. The T-waves are blunted in leads 1 and 2 and iso-electric in 3. (Patient, Mrs. N. H.; date, April 17, 1936.)

subjective symptoms of all patients were practically nil, as all were ambulatory and none complained of any particular symptoms. Only one patient stated that she suffered from heart disease, but no definite diagnosis could be made from the routine questions asked.

The ages of these patients ranged from 16 to 70 years. Eleven were male, fifteen female.

In the control electrocardiograms, the rate of the heart varied from 70 to 120 beats a minute. Two patients had a rate of 70, nine a rate of 80, nine a rate of 90, four a rate of 100, one a rate of 110 and one a rate of 120. Three were found to have extrasystoles of ventricular origin; the others were normal as to rhythm. Three cases showed changes in the electrocardiogram indicative of moderate heart muscle damage; while sixteen showed evidence of mild myocardial damage.

The changes noted are very similar to the changes that would be expected in persons of these ages and of this social status, the majority being charity patients referred from relief headquarters. The interpretation of the electrocardiographic findings is as follows:

In twenty-two of the twenty-six patients, different solutions were used on different days in order that a comparative study of the patient's reaction to the different solutions could be made.

In five patients, electrocardiograms were made before and after the injection of Ringer's solution. Figures 2 and 3 show electrocardiograms made for the patient before and after injection.

The average increase of the heart rate was 6 beats a minute.

The rhythm remained normal and other electrocardiographic findings were unchanged.

In six patients, electrocardiograms

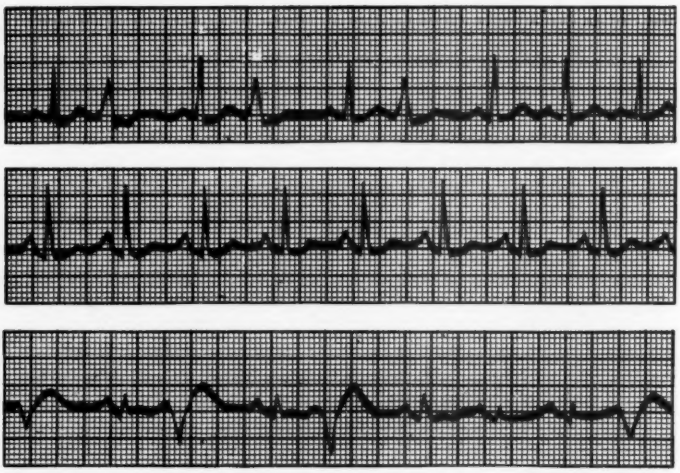

Fig. 9.—Electrocardiogram after injection of procaine 2 per cent with epinephrine 1:50,000. (Compare Fig. 8.) Multiple extrasystoles have developed. The rate has increased to 110. There are definite T-wave changes. (Patient, Mrs. N. H.; date, April 17, 1936.)

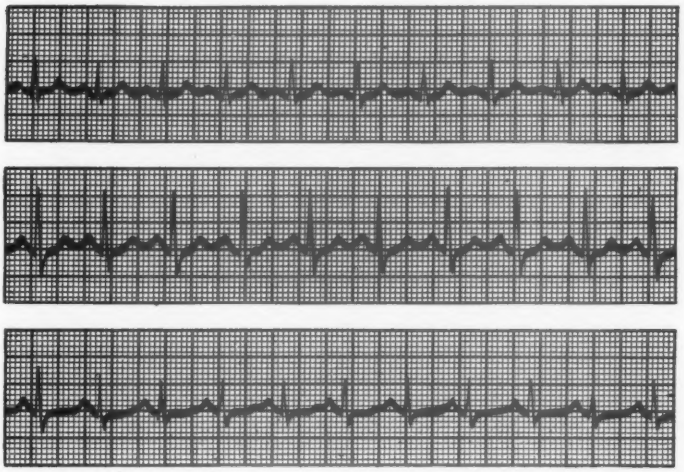

Fig. 10.—Electrocardiogram before injection of procaine 2 per cent with epinephrine 1:75,000. The rate of the heart is 120. The rhythm is normal. The QRS is of normal contour. The T-waves are upright in leads 1 and 2 and flat in 3. (Patient, Mr. K.; date, May 1, 1936.)

Fig. 11.—Electrocardiogram after injection of procaine 2 per cent with epinephrine 1:75,000. (Compare Fig. 10.) The rate of the heart is 140. The rhythm remains the same. The T-waves become blunted in leads 1 and 2 and slightly diphasic in 3. (Patient, Mr. K.; date, May 1, 1936.)

were made before and after the injection of procaine 2 per cent with epinephrine 1:20,000. Figures 4 and 5 show electrocardiograms made for the patient before and after injection.

The average increase in the heart rate was 30 beats a minute.

No change in rhythm was noted.

In 83 per cent, a definite change in the T-wave of the electrocardiogram was noted.

increased in number. Otherwise, the rhythm was not changed.

In one case, the P-wave (auricular complex) was inverted after the injection.

The T-waves were changed in all seven cases.

In five patients, electrocardiographic tracings were taken before and after the injection of procaine 2 per cent with epinephrine 1:50,000. Figures 8 and 9

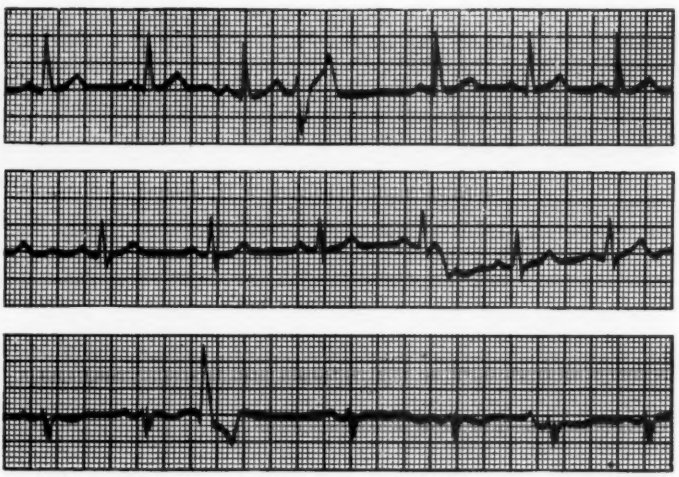

Fig. 12.—Electrocardiogram before injection of procaine 2 per cent with epinephrine 1:100,000. The rate of the heart is 80. There are extrasystoles of ventricular origin. The QRS is notched in lead 3. The T-waves are upright in leads 1 and 2 and slightly diphasic in 3. (Patient, Mr. S. N.; date, June 2, 1936.)

In seven patients, electrocardiograms were taken before and after the injection of procaine 2 per cent with epinephrine 1:25,000. Figures 6 and 7 show electrocardiograms made for the patient before and after injection.

The average increase in heart rate was 27 beats a minute.

In two patients who had extrasystoles before injection, these contractions were

show electrocardiograms made for the patient before and after injection.

The average increase in the heart rate was ten beats a minute. One patient developed ventricular extrasystoles. The electrocardiograms in two cases showed minor T-wave changes, and in three cases the records remained unaltered.

In five patients, in electrocardiograms made before and after the injection of

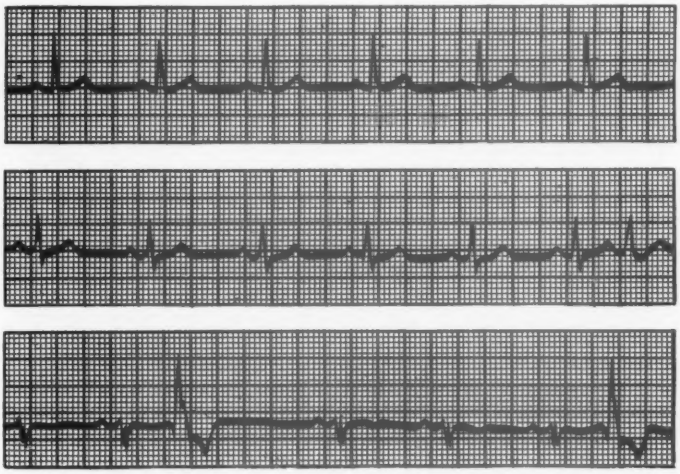

Fig. 13.—Electrocardiogram after injection of procaine 2 per cent with epinephrine 1:100,000. (Compare Fig. 12.) The rate remains the same. Extrasystoles are again present and there are mild T-wave changes in all three leads. (Patient, Mr. S. N.; date, June 2, 1936.)

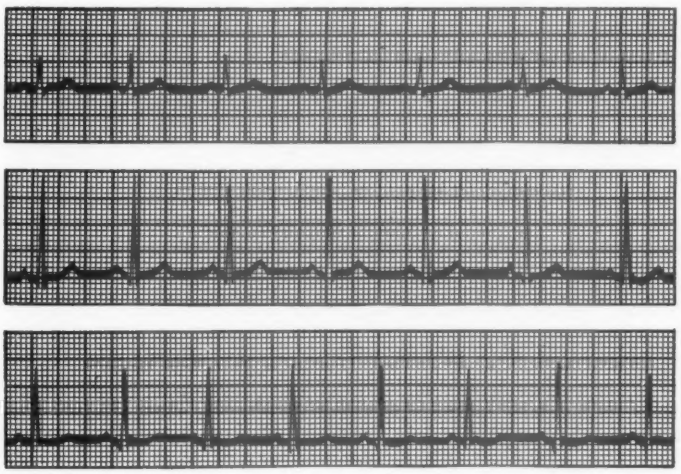

Fig. 14.—Electrocardiogram before injection of procaine borate 2 per cent with epinephrine 1:31,250. The rate of the heart is 85. The rhythm is of sinus mechanism. The axis deviation is normal. There is a small Q-wave in leads 2 and 3. The T-waves are blunted in lead 1, upright in 2 and flattened in 3. (Patient, Mr. J. H.; date, May 26, 1936.)

procaine 2 per cent with epinephrine 1:75,000, the average increase in the heart rate was nine beats a minute. Figures 10 and 11 show electrocardiograms made for a patient before and after injection.

The rhythm was not changed in any case. In one, there was a minor change in the T-wave.

In five patients, in electrocardiograms made before and after the injection of procaine 2 per cent with epinephrine 1:75,000, the average increase in the heart rate was seven beats a minute. Figures 12 and 13 show electrocardiograms made for a patient before and after injection. One case had extrasystoles of ventricular origin prior to injection and these were not noticeably increased after injection. Four of the cases showed a slight variation from the control electrocardiogram.

In five patients, with the same procedure, after the injection of procaine borate 2 per cent with epinephrine 1:31,250, the average increase in the heart rate was 11 beats per minute. Figures 14 and 15 show electrocardiograms made for the patient before and after injection.

The rhythm was not altered. There were T-wave changes in all cases.

In sixteen patients, in electrocardiograms made before and after the injection of procaine 2 per cent and cobefrin hydrochloride 1:10,000, the average increase in heart rate was only eight beats a minute. Figures 16 and 17 show electrocardiograms made for the patient before and after injection.

Only one case developed an extrasystole, and, in two cases, a slight T-wave change was noted.

The blood pressure, pulse and respiratory rate in the same group of patients were analyzed, and, as in the electrocar-

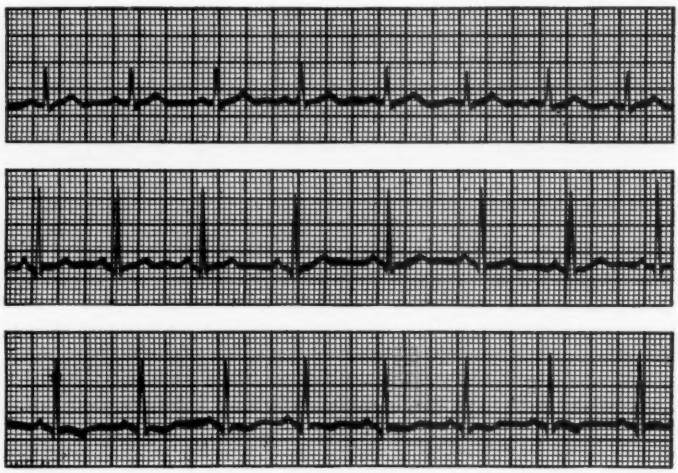

Fig. 15.—Electrocardiogram after injection of procaine borate 2 per cent with epinephrine 1:31,250. (Compare Fig. 14.) The rate of the heart is 100. The rhythm has not changed. The axis deviation is the same. The T-waves are more blunted in lead 1, slightly diphasic in 2 and definitely diphasic in 3. (Patient, Mr. J. H.; date, May 26, 1936.)

Fig. 16.—Electrocardiogram before injection of procaine 2 per cent with cobefrin hydrochloride 1:10,000. The rate of the heart is 100. The rhythm is normal. The axis deviation is normal. The QRS is notched in lead 3. The T-waves are blunted in 1, flat in 2 and inverted in 3. (Patient, Mrs. A. H. M.; date, March 20, 1936.)

Fig. 17.—Electrocardiogram after injection of procaine 2 per cent with cobefrin hydrochloride 1:10,000. (Compare Fig. 16.) The rate of the heart has not changed. The rhythm is the same. There is no change in the QRS complex or the T-waves. (Patient, Mrs. A. H. M.; date, March 20, 1936.)

diograms, varied in direct proportion to the concentration of the vasoconstricting agent used. The use of the 1:20,000 solution of epinephrine with procaine 2 per cent caused the most severe changes, consisting of a definite increase in the pulse rate and pulse pressure, with frequent variations in the respiratory rate.

The use of solutions containing a smaller amount of epinephrine was accompanied by milder variations, with even fewer changes noted when cobefrin hydrochloride 1:10,000 with procaine 2 per cent was injected.

The hydrogen-ion concentration of prepared local anesthetic solutions has, of late, become a subject of much active discussion. Sollman, in his "Manual of Pharmacology," third edition, describes the hydrogen-ion concentration of many of the body fluids. Under the heading of "Muscle Tissue," he explains the work of Schmidtmann, who, by using the *intra vitam* stains, found the hydrogen-ion concentration of muscle tissue remained 6.6 to 6.7, even though the tissue juices immediately surrounding varied from 5.2 to 8.2. It is evident that the p_H of the tissues and their fluids is by no means so easily disturbed as we have been led to believe. From a clinical standpoint, we found little variation in the promptness and intensity of anesthesia, postoperative discomfort or other complications that could be traced to the procaine solutions used, whether they were on the acid or on the alkaline side.

SUMMARY

A summary of the studies just recorded leads us to the belief that injection of the epinephrine solutions in all concentrations has some effect on the cardiac mechanism. There was a consistent change in the heart rate, which varied in direct proportion to the concentration of the epinephrine solution employed. Furthermore, it appeared that the T-wave changes in the electrocardiogram were proportionately greater as the concentration of the epinephrine was increased.

Extrasystoles did occur, both before and after the use of solutions of procaine with epinephrine, but, in this small series of cases, their frequency was increased after the injection of this combination.

Generally speaking, it is our impression that disturbing clinical symptoms were mild or absent when weaker concentrations of epinephrine or cobefrin hydrochloride 1:10,000 with procaine 2 per cent were injected, and the electrocardiograms serve as an objective record to substantiate these impressions.

55 East Washington Street.

THE MANDIBLE AND ITS POSTNATAL DEVELOPMENT: A STUDY OF FUNCTION AND ENVIRONMENT AS AIDS IN THE DEVELOPMENT OF THE DENTAL MECHANISM*

By ROBERT DUNN, D.D.S., San Francisco, Calif.

IN the study and practice of dentistry, as in other arts and sciences dealing with disorders in man, the fundamental objective is prevention, and on the road are interception, correction and repair.

In the latter phase, for the most part, professional interest is concentrated. Nevertheless, and with ever-increasing emphasis, society's demand is that knowledge be increased toward prevention. Until arrival at that state which prevents, and which now seems quite remote in the face of present-day conditions, it would appear that mankind may best be served by study to increase understanding of the forces of growth and development.

Thus, the purpose of this presentation is to stimulate greater interest in growth and development of the dental mechanism through a better understanding of the values of orthodontic interception.

It is hoped that the present general confusion may be somewhat lessened by mentioning the findings of others who have studied the growth of the dental mechanism as well as reporting my own observations over many years of clinical experience.

Considering the general acceptance by dentistry and medicine of the findings of physical anthropologists on the evolution of man (especially the evolution of the jaws and face, as presented by Gregory,[1] who states that we are creatures of environment), and further considering from its morphologic aspect the mandible (which, unlike the maxilla, is singularly free from congenital abnormalities), it is remarkable that so little thought has apparently been given to the important part the mandible, as an integrator, plays in the development of the dental mechanism, as well as being a dominant factor in disharmony. Such studies as have been made appear restricted within narrow limits.

FUNCTION

In the years of my experience with special study given to the mandible in its variables, it became quite obvious that in the evolution of the jaws and face, there has been created in the mandible, through its evolution, the especial function of establishing and controlling balance in the dental mechanism. It thus became the arbiter of type of occlusion, facial expression and speech, at times influencing mental poise. I have also found that the mandible with its component parts is a highly complex mechanism and, figuratively speaking, is most illusive, because of its mobility and the fact that the meniscus is readily change-

*Read before the Section on Orthodontia at the Seventy-Eighth Annual Session of the American Dental Association, San Francisco, Calif., July 15, 1936.

able in form and position. Many times, its exact relation is not evident, nor can it be determined through any mathematical formula. Alexis Carrel,[2] in "Man the Unknown," states that "relations that can be expressed in mathematical terms do not possess greater reality than those that cannot be so expressed."

Fig. 1.—The first postnatal vertical growth occurs in the mandibular incisor region, the earliest indication of the function of the mandibular incisors as determinants of dental spacing. (Figs. 1-7, courtesy of Frederick B. Noyes.)

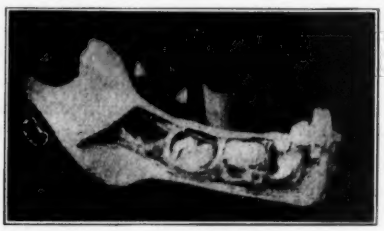

Fig. 2.—Later indication of action of mandibular incisors as gage in development of dental space and in influencing change in angle and vertical growth in ascending ramus.

It is the disturbance of the function of the mandible as an arbiter of growth that is responsible for so many dental anomalies. In fact, the percentage is so great that the matter should receive the earnest consideration of all students of dentistry; affecting, as it does, the profession in all its branches. It is amazing how many failures in orthodontics can be traced directly to the variation in the mandible, as can failures of reconstruction and treatment in other cases.

GROWTH

Owing to the magnitude and complex-

Fig. 3.—Portion of jaw in which results of anterior mass movement of growth in incisor region, with increase in height of incisors, change in angle and increase in height of ascending ramus, may be noted.

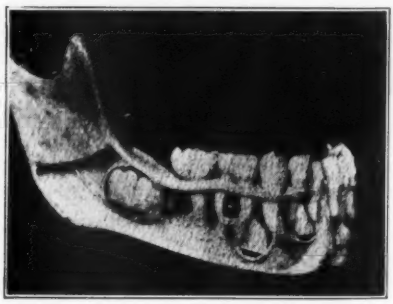

Fig. 4.—Full balance in mandibular deciduous dental mechanism as of that period of growth.

ity of the subject, I shall confine my discussion to that phase of growth on which width and particularly length and relation of the mandible are dependent. Other than for the purpose of emphasis, I have avoided discussion of fundamental

causative factors and the treatment of disharmony.

It has often been stated that "if we are to know the reason of disharmony, we should first know the reason of the harmony." Stein,[3] in his discussion, "Waymarks of the Mandible and Maxillae," states that "the key to malocclusion is to be sought in the cause and maintenance of normal occlusion." It might be added that when more has been learned about the reason for harmony, or balance, in the dental mechanism, there should be less that is spectacular, with more simplicity and greater success in treatment than now prevails.

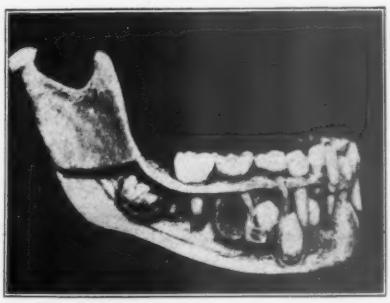

Fig. 5.—First permanent mandibular molar assuming its position as pillar of height.

THREE CARDINAL POINTS

Nature, as in all other growth and development, has a definite plan in the development of the normal dental mechanism, and in this great scheme of sequence of erupting teeth and the shifting of their positions in the process is the influencing factor, with growth and eruption of teeth in the mandible dominating. Any deflection in this orderly process results in disharmony in some degree in the mechanism. Outstanding in this phenomenon are three cardinal points. Coordinating in the governing of balance in the mechanism, as I shall endeavor to show, are the mandibular incisors, both deciduous and permanent, the ascending ramus with condyle head and the mandibular first molar.

POSTNATAL CHANGES

At birth, the mandible is always posterior to its normal later position. Through natural sucking at the mother's breast, it assumes a more anterior relation. From this stimulus (Fig. 1), there also occurs an increase in vertical growth in the incisor region simultaneously with a change in the angle and an increase in growth vertically of the ascending ramus. These are the first indications in postnatal growth that are to determine what is known in prosthodontics as the denture space. In the specimen, obtained after birth, it will be noted that the condyle of the ascending ramus is very little above

Fig. 6.—Mandibular first permanent molar in conjunction with maxillary first permanent molar maintaining balance in dental mechanism and thus relation of mandible during transition period from deciduous to permanent denture.

the upper horizontal plane of the body of the mandible.

The next outstanding and more rapid change is in the eruption of the mandibular deciduous incisors. (Fig. 2.) At this stage, if the nursing has been natural, the mandible will have assumed a more anterior position and one more in keeping with that balanced relation that will exist on the full eruption of all deciduous teeth. The eruption of the incisors at this period in the infant's growth is therefore seen to be primarily for the important purpose of acting as a gage in the determination of the denture space, or

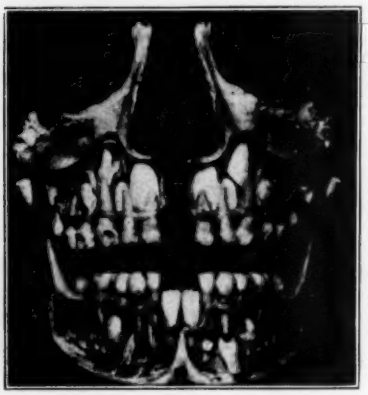

Fig. 7.—Lingual inclination of permanent teeth, natural position of all teeth before eruption.

better, vertical growth in the lateral halves and the influencing of the angle and height or length of the ascending ramus.

If this illustration is compared with Figure 3, it will be noted there has been an anterior movement of mass growth as represented in the incisor region (Fig. 3), which means length growth, as well presented by Hellman. To be noted with the increasing height of incisors is change in the angle and increased height of the ascending ramus. At this age, the child is still on liquid food, but soon will be placed on semisolid diet. As, in their vertical position, the deciduous teeth and the condyle head of the ramus are in balance, provision must be made for their support during mass movement or length growth, in order to provide space for the future needs of mastication. Thus the first deciduous molar erupts. If, for any reason, this tooth should fail to attain its exact vertical position, the following cuspid will not be given the opportunity to change fully from its lingual inclination on eruption and, in addition, through its contact with the lingual plane of its max-

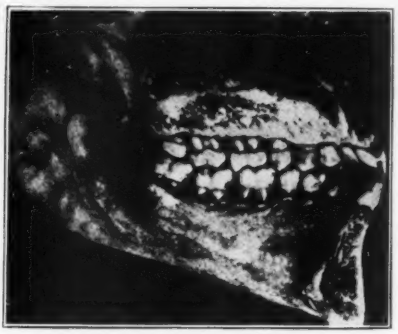

Fig. 8.—Normal lingual cusp relation of teeth in occlusion. (Courtesy of M. H. Cryer.)

illary antagonist, the segment of the dental arch as represented by the incisors and cuspids is constricted. Unless there be a spurt of vertical growth on the eruption of the second deciduous molar, which frequently does not occur, the next tooth in this sequence—the first permanent molar and most important in the phenomenon—will not assume its full vertical position, and there will result malocclusion in the permanent denture, the involvement depending on the degree of arrest of vertical growth.

In Figure 4, the vertical growth in

lateral halves, anterior mass movement of growth and length in the ascending ramus are all portrayed. No close observer of growth under orthodontic appliances can fail to observe this phenomenon nor the effect of a failure to make provision for it.

Fig. 9.—Failure of teeth in lateral halves of mandible to obtain full vertical upright positions; resulting in overlapping or crowding of mandibular incisor.

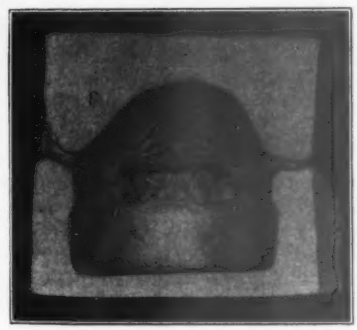

Fig. 10.—Lingual aspect of occluded casts of Figure 9, showing abnormal cusp relation due to lingual inclination of teeth in lateral halves of mandible, full vertical growth in lateral halves of mandible thus being arrested.

VERTICAL GROWTH

We have now arrived at the most critical period of growth in the dental mechanism, the completion of eruption of the deciduous denture. An amazingly large percentage of cases of malocclusion have their inception at this period owing to arrest of vertical growth in the lateral halves of the mandible. It would appear that vigorous use of the deciduous teeth

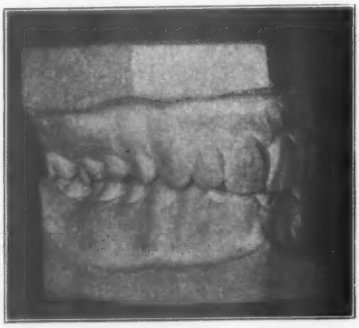

Fig. 11.—Arrest of vertical growth in lateral halves of mandibular permanent denture following arrest of vertical growth in mandibular deciduous molar region.

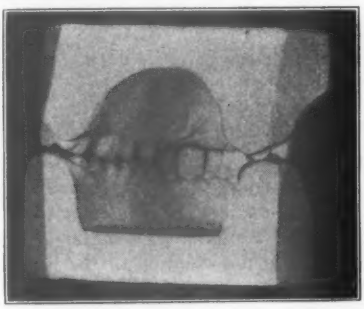

Fig. 12.—Lingual aspect of occluded models of Figure 11, showing abnormal lingual cusp relation of teeth in lateral halves and overlapping or crowding of mandibular cuspids and incisors. The vertical arrangement of the mandibular incisors is normal.

in the lateral halves is the agent which stimulates a certain trophic center to action, and which at this critical period has

become less active than is essential to normal growth, owing, possibly, to modification of the environment that was responsible for the evolution of the dental mechanism.

It is necessary that further vertical growth in the lateral halves of the mandible take place during the full period of the deciduous dentition, not only as compensation for the wear of occlusal surfaces of the teeth, but also to provide for the orderly eruption of the mandibular first permanent molar (Fig. 5), which is the third and most important point in sustaining balance in the mechanism. The sequence of eruption of this tooth is not primarily intended to add to the area of the masticatory surface only. More particularly, it is to support the ascending ramus and condyle head, and thus to aid in maintaining the balance and relation of the mandible during that transition period from the exfoliation of the deciduous to the eruption of the permanent denture. (Fig. 6.)

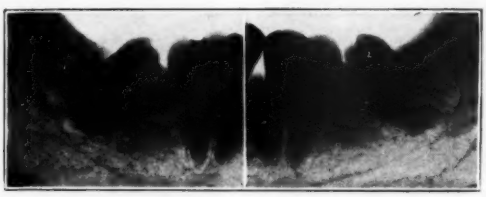

Fig. 13.—Impaction of third molars due to arrest of mandibular length growth as result of arrested vertical growth in lateral halves of mandible. (Case shown in Figures 11-12.)

PILLAR OF HEIGHT

As the salient point in the sequence of development, the mandibular first molar moves to its full vertical position. It may well be termed the great pillar of height, which it truly is, as any disturbance interfering with its functioning as such will certainly result in disharmony in the dental mechanism. Because of its designated function as the pillar of height, it can be seen how its abuse from mechanical force, while in use as an anchorage in orthodontics or in restorations, may easily, in the former case, complicate treatment even to the point of failure and disfigurement. In the latter case, permanent impairment of the dental mechanism results. Attention is again called to increased length of ramus and change in the angle.

The permanent mandibular incisors, like their predecessors, invariably erupt to a designated vertical position, similarly to the manner of the long bones in the extremities as to their length. When mechanically depressed—not tipped—they will, on release, return to their original designated position.[4] The incisors, because of this phenomenon, coupled with improperly erupted first molars, become powerful factors, through undue contact with the lingual incline planes of the maxillary incisors, in forcing the mandible, because of its susceptibility, into various malrelations. Where mandibular incisors have been crowded out of their line of occlusion, owing to insufficient vertical growth in the deciduous denture, two or more of them will be found normal in vertical position.

The lingual inclination of unerupted teeth, amply demonstrated in this specimen (Fig. 7), is the natural position of all developing teeth, both deciduous and

permanent, the teeth gaining height and the dental arch, width as they move to their position. This permits full length growth of body, with no impaction of third molars (the process being likened to that of widening the angles of a triangle at its base), verified, if desired, by close observation of erupting teeth.

ANCIENT TYPE

In the examination of sixty early California and Peruvian Indian skulls, with their mandibles and most of their teeth present, with but one exception there was no evidence of arrest in this phenomenon of vertical growth and that was of a young California female, which no doubt

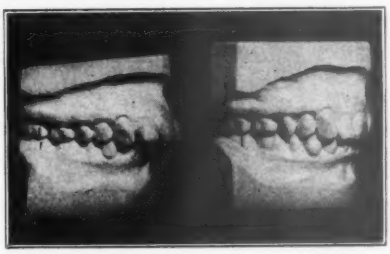

Fig. 14.—Extreme arrest of vertical growth in lateral halves of mandibular dental arch associated with traumatic gingivitis.

was of a more recent period. The occluded jaws, when observed from the lingual aspect, were all found to be similar to the specimen shown in Figure 8, the lingual cusps of mandibular teeth fitting closely the lingual cusps of maxillary teeth.

MODERN TYPE

In the study of several hundred casts of malocclueded teeth preserved over a period of thirty years, quite a different relation has been found. In more than 80 per cent, the lingual cusps of mandibular teeth fail to meet, in varying degree, the cusps of maxillary teeth in the manner as shown; which indicates that the disturbance in this phase of growth is due to present-day environment.

In Figure 9 are shown models of a case of Class 1 and as nearly the Indian type as could be found. This is an excellent specimen for comparison with Figure 8. From the lingual occlusal aspect (Fig. 10), it will be noted that the first and second molars in the lateral halves of the mandible fail to obtain their full upright position. The effect in the incisor region is clearly seen.

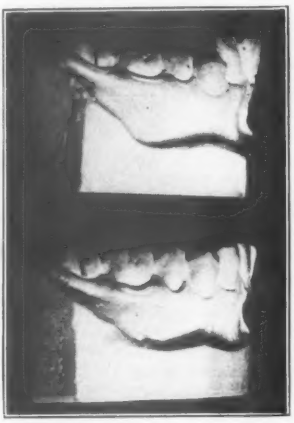

Fig. 15.—Transverse aspect of mandibular casts before and after treatment of case shown in Figure 14. In the lower cast, closer approach to a vertical arrangement in molars and bicuspids is evident.

ARREST OF VERTICAL GROWTH IN THE LATERAL HALVES OF THE DECIDUOUS DENTURE

Where the arrest of vertical growth in lateral halves of the deciduous denture exists, with its attendant arrest of length growth, rotation of mandibular first molars on eruption is the rule. This is due to the influence of the distal contour

or bulge of the second deciduous molar through the wedging effect of the first molar in retarded and arrested anterior mass movement of growth. The mandibular first molars are not permitted to move to their full vertical positions.

From the lingual inclinations of the mandibular first molars, there is a reaction on the maxillary first molars resulting frequently in their rotation, interfering in their proper buccal inclination, with consequent arrest of width growth in the maxillary arch (too often attributed to mouth breathing).

As previously stated, irregularity in the orderly exfoliation of deciduous teeth causes disorder in the sequence of erupting permanent teeth, which disturbs the vertical arrangement in the permanent mandibular teeth. In cases wherein arrest of vertical growth in lateral halves of the deciduous denture existed prior to the eruption of the first mandibular molar, the result may become quite complicated and extremely difficult to treat satisfactorily.

In unilateral distal occlusion, it will be noted that arrest in vertical growth is greater in the affected half than in the other half and appears on the side receiving the least use in mastication, the greater percentage, in my experience, being in the left half. The mandible, in such anomalies, should be considered rotated, a condition that, as a rule, is brought about through the mechanics of the cusps and inclined planes of the rotated molars as the latter come to occlusion.

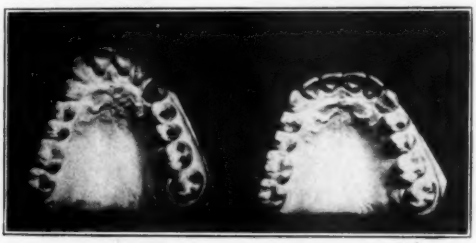

Fig. 16.—Occlusal aspect of maxillary casts of case shown in Figure 14, in which traumatic gingivitis is seen in cast on left. The right cast shows the clearing up of the gingivitis after treatment.

COMMENT

The type of arrest of vertical growth under discussion should not be confused with that described by Hellman[5] and Lewis[6] in their studies. They have shown cases of latent vertical growth in the lateral halves of deciduous dental arches or excessive overbite, which later, through some stimulus, was corrected. If recovery has not occurred before the eruption of the first permanent molars to occlusion, which it seldom does wholly, a condition of unbalance in the three cardinal points is the result. Eruption of permanent mandibular cuspids to their full height will, through contact of these teeth with the inclined planes of their maxillary antagonists, cause crowding in the mandibular incisor and cuspid region. Normal development of mandibular arch width is, of course, arrested. Figure 11, a good example of this, depicts the final result so often seen in orthodontic procedure. The full functioning of many of

such dental apparatus is of short duration, being the source of much trouble in later life, as are all disharmonies wherein unbalance, as just mentioned, exists. In the lingual occlusal view (Fig. 12), normal height incisors with lingual inclined molars and bicuspids are to be noted, with the inevitable impacted third molar as seen in the roentgenogram (Fig. 13).

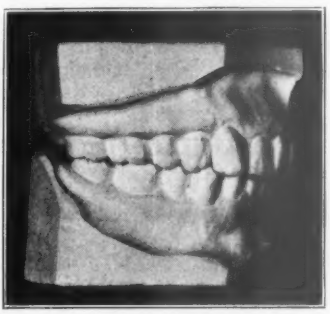

Fig. 17.—Cast of case shown in Figures 14-16, twenty years later.

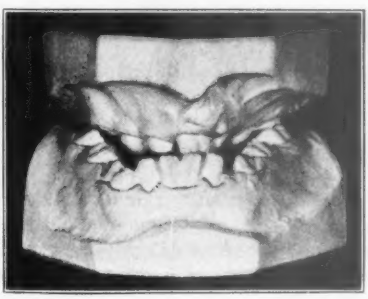

Fig. 18.—Case of cleft-palate in child, aged 11 years, showing lingual inclination of all mandibular teeth due to lack of use.

The prevailing impaction of mandibular third molars is but the result of arrested length growth, which is due to insufficient height in mandibular masticating teeth.[7]

We can produce no more convincing argument than that within the mandible there is to be found the key to malocclusion of Class 1 and of Class 2, as in the following cases: In a woman, aged 35 in 1916 (Fig. 14), the treatment was largely concentrated in obtaining increased height in mandibular molars and bicuspids, as portrayed in Figure 15, the transverse aspect. The upper model before treatment, the lower, after, clearly demonstrate the increased height of molars and bicuspids. To have gone beyond this point at this age would have

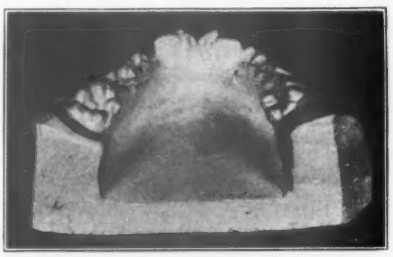

Fig. 19.—Occlusal aspect of mandibular cast of case shown in Figure 18.

Fig. 20.—Case shown in Figure 18. The obtuse angle can be seen, and there is evident an arrest in lengthening of the ascending ramus.

risked exposure of the cementum. Slight shortening of mandibular cuspids and incisors therefore was necessary. This might lead one to believe that, in this instance, the cuspids and incisors were excessive in vertical arrangement. In the case of the cuspid, that may be true, it being forced into position as indicated by the crowding; but not so with the incisors. It is believed that if increased vertical arrangement had been obtained in the maxillary molar and bicuspid region, the final result would have been more nearly ideal, as can be seen from the finished model in Figure 15.

Excessive or normal vertical growth in the mandible other than that just mentioned has not been observed, which might be considered by some as being more apparent than real.

In Figure 16, the maxillary arch of the same case from the occlusal aspect, the model on the left shows that traumatic gingivitis existed in the incisor region. In the model on the right, after treatment, a somewhat changed condition is seen, with pockets healed and teeth tightened and thus maintained until the latter part of 1935, when a slight flare-up occurred. The condition quickly responded to treatment; which indicates that there still exists a lack of full balance in the three cardinal points.

In orthodontics, time is the judge of success. Figure 17 portrays the same case in 1936, twenty years later. The models obtained through the intervening years are in my collection.

The frequent statement that dysfunction of muscles is an active factor in the disharmony is not in accordance with my experience. It is where we fail to obtain full coordination in the three cardinal points, which is mandatory to insure balance in the dental mechanism, that this apparent lack of muscular tonicity seems to be an active factor.

From experience in treating such cases, the arrest of length growth in the ascending ramus relatively appears to exceed the vertical growth in the lateral halves of the mandible. It is thus out of balance with the height of incisors, and with the harmonizing height of the teeth in the lateral halves with incisors, there remains the discrepancy in the ramus. Arrest of vertical growth throughout the skeletal structure is a frequent accompaniment. Great patience, time and the unusual in procedure are necessary to promote further length growth in the ascending ramus.

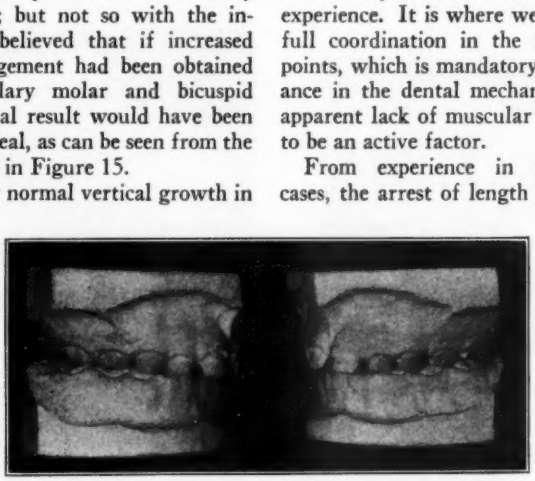

Fig. 21.—Case of arrest of vertical growth in lateral halves of mandible of 4-year-old child in which treatment was extremely simple.

USE

That use is the most important factor in furnishing the stimulus for the teeth

in the lateral halves of the mandible to assume their full upright vertical position becomes more convincing in the study of those cases of cleft-palate wherein the greater number of maxillary teeth are congenitally absent or destroyed, and thus the antagonism furnished by the maxillary teeth, that medium through which the stimulus is generated, is lost. Figures 18 and 19 illustrate the typical case. Although at times appearing to do so, the body of the mandible rarely, if ever, exceeds its normal length, nor does it, in other types, so frequently as has been credited to it; and while it is not always so, it will be noted that where excessive length of body actually exists, it is most frequently associated with length in long

A B

Fig. 22.—Case shown in Figure 21. The cast on the left shows the result of treatment after three years, that on the right, result after five years, the mandibular first permanent molar functioning as the great pillar of height.

bones of the extremities that are out of proportion to length in the torso. In the roentgenogram in Figure 20 is demonstrated the condition that usually exists, the angle of the mandible having failed to change from the obtuse, with pronounced arrest of vertical growth in the ascending ramus. The foregoing statements are convincing arguments that our goal must be interception.

INTERCEPTION

Interception in orthodontia should mean such treatment, and of the most simple kind, as may be given during the period of the maintenance of the deciduous denture, in order that balance may prevail during the transition period of growth and the development of the permanent dental mechanism.

The aim is to obtain greater height in the deciduous molar region and to guide the mandibular permanent first molars to the proper upright vertical position. To be successful, treatment should begin as soon as possible after the second deciduous molars have erupted to full occlusion and the disharmony warranting interference

Fig. 23.—Case of micrognathia in child aged 3 weeks. Vigorous use was the simple agent employed in correcting the extreme distal relation of the mandible.

becomes evident. The following demonstrates the contention (Fig. 21). In a case of arrested vertical growth in the deciduous denture of a 4-year-old child, presented in 1931, it is noted that the vertical overbite is so great that on eruption of cuspids in the left half of the area of occlusion, which were, no doubt, in advance of those on the right, the undue force exerted through their inclined planes, with the aid of the mandibular in-

cisors, rotated the mandible to an unilateral distal relation of the right side.

The sequence of erupting permanent teeth in such cases is as a rule irregular. The eruption of mandibular first permanent molars is retarded because of the arrest of anterior mass movement of growth, or arrest of length growth. The mandibular first molars, in some cases, follow the eruption of the maxillary first molars instead of preceding it. Figure 22 A and B shows models obtained after treatment in 1934 and in 1936, respectively. Here is noted (A) the disruption of the sequence, the mandibular first molars delayed in their eruption because

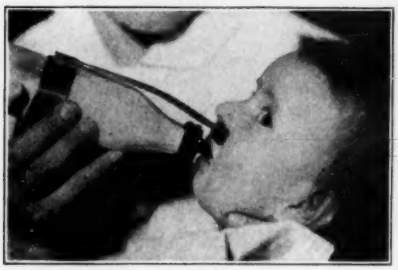

Fig. 24.—Appliance used to intensify vigorous use of organs as originally intended by nature.

of the previous arrest in mandibular length growth; the mandibular permanent incisors erupting to normal relation, and the increased height in the lateral halves of the deciduous dental arch obtained through treatment sustaining vertical arrangement until eruption of the first permanent molars. To be noted in B are the first molars functioning as pillars of height in coordination with the ascending ramus, and, hence, a normal mandibular relation.

Just a word of warning: Do not attempt to attain height by building up tooth material, as in onlays or crowns on deciduous teeth, as this will only defeat the object of treatment and, further, suddenly aggravate the unbalanced condition. Proper height can be obtained only through coordinating with Nature during growth, which requires time, always aiming to obtain and maintain coordination in the three cardinal points, as previously mentioned.

Earlier in this presentation, it was stated that width and length growth and relation of mandible were dependent on

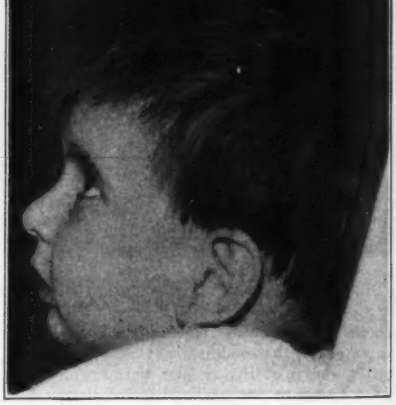

Fig. 25.—Appearance of patient at age of 11 months. The appliance shown in Figure 24 was still in use at this period.

vertical growth in the lateral halves. To avoid possible confusion, it must be mentioned that independently of the vertical growth, length growth and the relation of the mandible can be and are influenced through external mechanical force, as from a prolonged vicious habit. The improper use of the nursing bottle as described by Hellman is, in my opinion,

more potent in the disturbance of normal growth and development of the mandible than any other external factor. Recent experiments confirm this opinion and cause a growing conviction that a revolution in the present-day mechanics of artificial nursing must be brought about if the precentage of malformations is to be reduced.

An outstanding experiment will be observed in a case of micrognathia.[8] Figure 23 was obtained three weeks after

Fig. 26.—Appearance of patient at the age of 3 years. (Compare Figures 23-25.)

birth. Figure 24 illustrates the appliance and manner of use, the appliance being moved slightly forward on the bottle every other day, and thus, through the efforts in suckling, the mandible was gradually forced to its proper anterior relation.

In Figure 25, the child is 11 months of age; and Figure 26, 3 years.

SUMMARY

In the evolution of the jaws and face of man, there was created in the mandible the function of establishing and controlling balance in the dental mechanism, the mandible thus becoming the arbiter of type of occlusion, character of facial expression and clarity of speech, and influencing mental poise. It is in the disturbance of function, through its abnormal growth, that so many anomalies develop.

In this creation, there evolved the great scheme of the sequence of erupting teeth and the shifting of their position in the procedure, with growth and erupting teeth in the mandible dominating. Outstanding in this phenomenon, and coordinating, are three cardinal points in the governing of balance in the mechanism; namely, mandibular incisors, ascending ramus with condyle head and mandibular first molar.

To know the reason of disharmony, we must know the reason of harmony, which means knowledge of growth and development. Of the three phases of growth in the dental mechanism, vertical, depth or length and width, the vertical in the mandible is paramount; for on its normalcy, the other two are dependent, as is also the relation of the mandible. In this deficiency, there is to be found the causes of the greater percentage, by far, of malocclusion of Class 1 and of Class 2. Thus, the key to malocclusion of Class 1 and of Class 2 is to be found in the mandible and its irregularities of growth.

The salient feature in vertical growth is the mandibular incisors, which primarily function as the gage in determining the degree of the vertical arrangement of the teeth in the lateral halves of the mandible, and in influencing vertical growth and change in the angle of the

ascending ramus, and thus the relation of the mandible.

Transcendant in importance in the vertical arrangement of the teeth in the lateral halves of the mandible is the first permanent molar. Its designated function is sustaining height during the transition period from the deciduous to the permanent denture. It may rightly be called the great pillar of height in the development of the dental mechanism. Thus is seen the importance of its preservation.

We cannot continue in the quest for fundamental causes of malocclusion and hope to get very far without recognizing vigorous use during the period of the deciduous denture as a dominant stimulus to that agent in control of vertical growth.

At times, it appears that retrusion of the mandible is the result of the modification of that environment which was responsible for the evolution of man and is but a step backward in the evolution to another type, as considered by some physical anthropologists. Nevertheless, interceptive treatment should be the method. Its success, of course, is dependent on knowledge of the reason of balance and causes of imbalance in the dental mechanism.

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209 Post Street.

MANAGEMENT OF SOFT TISSUES IN ORAL OPERATIONS*

By HANS W. SORENSEN, D.D.S., F.A.C.D., San Francisco, Calif.

THE necessity for speed was plainly indicated in the practice of oral surgery, especially exodontia, in the days before local anesthesia and the use of an improved technic in the administration of nitrous oxide. In those days, the operator had only a few minutes in which to extract one or more teeth, for which reason rapidity was valuable and essential. The operator who could get the tooth in the first attempt was lauded as an artist.

This particular technic was responsible for the development of the alveolar forceps. These forceps were designed with long beaks and long blades with sharp edges. The beaks were sufficiently large to enable the operator to engulf the soft tissue, alveolar process and root or roots of the tooth. The handles were extra long, which permitted a sufficient or probably an excess purchase, and allowed the operator to get his pound of flesh. In fact, it was the first *en bloc* operation. While this may seem brutal to us now, at that time it was considered, and was, a far more humane method of extraction than the old way of breaking off the crown and groping for the roots for hours, with inefficient instruments; a method which, in the long run, caused more trauma and discomfort to the patient, and usually resulted in a slower and less satisfactory repair of the process than the use of the alveolar forceps. It is regrettable and unfortunate that, even in this day of prolonged and safe anesthesia, especially local anesthesia, where excessive speed and force are not indicated, many operators sacrifice the gentler technic of tooth removal for speed, and, in their haste, unnecessarily mutilate the soft tissues, assured by the odd conclusion that wounds heal readily under most conditions in the oral cavity.

It is an accepted rule in general surgery that the least possible manipulation of any tissue in the field of operation causes less shock and assures better postoperative results than unnecessarily rough procedures. While this is especially true in abdominal surgery, it is by no means a negligible factor in surgery of the mouth, the tissues of which receive their nerve supply principally from the fifth nerve, the principal sensory nerve. It is true that the sensory impulses are blocked in local anesthesia, and no shock is transmitted from the field of operation to the general nervous system, except those of a psychic nature; but there is the postanesthetic stage wherein pain reacts on the general nervous system, the severity of the pain depending on the degree of trauma and the temperament, age and resistance of the patient. To clarify this statement, and to show the reaction to surgical interference of different persons, without dwelling for the moment on the recovery of bruised and lacerated tissue, with its various stages of inflammation and repair, attention is called to ecchymosis, which can be produced in some

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persons by merely a bump or firm grasp. This hypersensitiveness to trauma in normal persons does comparatively little or no harm, but may result in serious complications in patients whose recuperative powers have been lowered by blood dyscrasias or by cardiac, digestive or trophic disturbances.

It is an agreed fact in medicine that the periosteum is a vital factor and a most important aid in the healing of bone fractures. It is the consensus of opinion that periosteum when in contact with bone is an osteogenetic membrane. Be that as it may, it is generally agreed that periosteum is a means of supplying nutrition and affording protection for bone, and thus aids in its regeneration and repair, and when this membrane is mutilated or destroyed, bone regeneration and repair will be greatly interfered with as well as the postoperative comfort of the patient, and, in many cases, this mutilation will have grave sequelae. No less important is the mucous membrane and connective tissues which protect the periosteum and through which it receives most of its nourishment. In any operation in the oral cavity, proper exposure of the field, with as little interference as possible with the blood vessels supplying the retracted soft tissues, will greatly aid healing and return to normal. This can best be done by avoiding, as nearly as possible, any transverse incisions. In order to assure access and visibility to the field of operation, the tissue around the necks of the adjoining teeth should be merely loosened and retracted. The soft tissue is then in one piece, and, when returned to its position and sutured to place, readily attaches itself to the bone.

There is a definite variation in resistance to trauma of the palatal, buccal and lingual aspects of the maxilla and mandible and their postoperative reactions. The most favorable operative area is the palatal surface of the maxilla, with its thick mucoperiosteum, generous blood supply and adequate drainage. In any operation in this region, such as the removal of palatally impacted cuspids or cysts, there are two accepted methods of approach: an incision about 2 mm. from the necks of the anterior teeth on the side of operation, around to the median line; or loosening of the gingival tissue around the necks of the teeth back as far as the first molar. The latter method interferes less with the blood supply to the retracted tissue, as there is no danger of cutting the descending arteries.

The buccal and labial aspects of the maxilla and mandible, with the exception of the buccal area in the region of the third molars of the mandible, are also favorable sites. The labial aspect of the maxilla often presents a problem, especially in short lipped persons, in whom the cervical regions are more or less normally visible, and any loss of tissue would result in a permanent disfigurement. Usually, in the more prominent cases of this type, the cervical and labial mucoperiosteal tissues are thin and tightly drawn over a thin and flinty labial plate of underlying osseous structure, with a none too rich circulation. In operating in these cases, the cervical soft tissues and the labial plate should be conserved, in order to improve the appearance of an anterior bridge, especially in the region over the cuspids. Rather than break down any of the structures mentioned, it is better to remove the root palatally; or, by making a crescent-shaped incision between the cervical margin and the apex of the tooth, as in an apicoectomy, remove the root through the window or force it out through the socket. Before retraction of the soft tissues upward, a suture should be inserted through the mucoperiosteum to keep the tissues from separating. After the tissues have been returned to their normal position and sutured, this suture

is removed. In cases wherein the labial plate is said to be "frozen to the root," it should first be detached by carefully passing a very thin-bladed chisel under the free margin of the cervical tissue and, with gentle tapping, driving the chisel between the process and the root. Usually, the plate can be detached from the root without injury. Should the plate be fractured, it can be pressed into place after the root has been removed, as it will still be attached to the uncut mucoperiosteum, and thus have a sufficient blood supply to assure its repair, which would otherwise be impossible.

In the buccal region of the mandibular third molars, drainage is not so favorable as in corresponding areas in the maxilla. In removing deeply impacted third molars in this region, it is necessary to make a buccal incision, as well as the incision running posteriorly from the second molar. This buccal incision should begin at a point approximately 1 mm. distally from the second molar and extending downward and forward to the mesial aspect of the second molar. As a rule, it needs no suturing, but suturing is an easy matter, as the incised edges approximate naturally. The suture merely acts as a "tack" to hold the flap to the normal undisturbed mucoperiosteum during musculation of the buccal tissues. To determine whether this is necessary, the cheek movements are tested to see whether the flap moves. In this area, the incised soft tissue is apt to take in air, foreign matter or débris between its retracted layers, if the flap is not first "tacked" together by a suture and held firmly by a suitable retractor. By this simple precaution in handling the soft tissues in this area, the danger of emphysema and postoperative cellulitis can be greatly minimized. Undue manipulation of the flap should be assiduously avoided.

Fourth in recuperative power is the lingual aspect of the mandible. Its deficiency in this respect is due to the lack of blood supply, arising from the variation in density of the lingual plate and the extreme thinness of the mucoperiosteum, which, when mutilated, undergoes repair very slowly. Most vulnerable is the lingual area posteriorly, beginning in the region of the third molar and including the tissues which lie between the internal surface of the ramus and the fauces. The tendency to severe reaction in this region may reasonably be attributed to the mobility of the soft tissues, inadequate drainage and the fact that foreign substances may easily become trapped in the wound. These areas can be operated on without undesirable sequelae if one bears in mind the pitfalls present and practices a carefully planned technic.

This area is often invaded in trimming a very prominent internal oblique ridge or removing an impacted third molar lingually. A technic found to be very satisfactory for either of these operations is as follows: A clean incision is made with a sharp scalpel from the distal aspect of the second molar backward and up the anterior border of the ramus as far as is necessary. The gingival tissue around the necks of the first and second molars is loosened, and the whole gingivolingual structure is loosened and held by a suitable retractor without a transverse incision. With the retractor in position, the wound is now packed with iodoform gauze, to prevent débris and foreign matter from entering during the operation. The retractor used in this location not only should retract the soft tissues but also should be of a type to hold the tongue in position, at the same time allowing good visibility and permitting proper breathing by the patient. As soon as the operation is completed, the pack is removed and free hemorrhage permitted, as blood is the best wound cleanser. The

soft tissues are returned to normal position and sutured.

Trauma to the soft tissues can be greatly minimized by proper retraction of these tissues. It must be remembered that retraction is in a direction away from a convex surface of bone buccally and labially, and a concave surface lingually and palatally. To facilitate retraction, the teeth of the retractor should be so arranged that, when in position, they will rest on the bone at all points. A proper retractor should be so designed that, when in place, it can be held at the seat of the operation without slipping, until the operation is completed. If it is necessary to let the patient cough or expectorate, the flap should be returned to its normal position. The success of the operation and convalescence are greatly aided by a careful technic in handling the retracted gingival tissue.

IN CONCLUSION

It must be remembered that the value of gentleness in handling the soft tissues of the mouth cannot be overestimated, and that care and conservation of the investing tissues, in the removal of teeth, will often result in years of benefit in masticatory comfort and improvement of the personal appearance of the patient, besides giving the operator a great sense of satisfaction. As injured tissues always heal best when at rest, the soft tissues should be stabilized by well-placed sutures. The mucoperiosteum then makes an excellent bandage for the injured osseous tissue. As the function of a tissue depends on the normal condition and relation of its cellular structure, its rapid recovery from surgical interference depends largely on the reduction of trauma to the minimum.

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THE EDENTULOUS MOUTH AND FOCAL INFECTION

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THE possibility that an edentulous mouth may be the site of a focus of infection was brought to my attention very forcefully by a recent case. While there was no systemic involvement in this case, it made evident the fact that the mouth is still a possible site of focal infection, even though all the teeth have been removed.

Mrs. C., housewife, aged 45, came in for the first time with the complaint that her artificial denture was cutting the gums and a request that it be trimmed. Clinical examination showed the upper left cuspid area to be tender and swollen, having all the appearance of an acute alveolar abscess. At one point, there seemed to be pus near the surface, but there was no indication whatsoever that the denture had caused the condition. A roentgenogram revealed that, while no retained root was evident, there was a definite area such as is associated with residual infection. The abscess was lanced and a quantity of pus obtained.

This case prompted the question as to whether the edentulous mouth is universally recognized as a possible source of focal infection. The only way to answer the question was to review the available

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literature of the past twenty years. Very few articles on residual infection were found, but there were numerous articles on diagnosis and focal infection. From these, an occasional case history was obtained.

MacNevin and Vaughan,[1] in their book "Mouth Infections and Their Relation to Systemic Disease," merely mention "residual infection after extractions" as one of ten dental sources of focal infection.

Molt,[2] in a very good article, has the following to report:

> Logan, in 1921, reported thirty-five cases of edentulous mouths, eight with retained roots and five with periapical lesions.
>
> Gilmer, about the same time, reported a series of edentulous mouths with a nominal number of "unhealed areas."
>
> Molt, in 1922, reported a series of 900 areas examined, 48 per cent of which showed remaining roots or evidences of residual or retained infection.
>
> Eusterman, of the Mayo clinic, reports a series of 290 patients examined during a six months' period, of which number eighty-nine wearing dentures showed 129 roots and nine "residual areas." There were also found thirteen embedded or partially erupted teeth.

In the same article, Molt lists five conditions that may be found in edentulous mouths: 1. Broken-off root fragments with or without pathologic areas, which include roots forced into the antrum. 2. Impacted teeth that, having remained unerupted for a long period of years, have no opportunity to erupt even though the overlying teeth were extracted. 3. Cysts, originally radicular, but remaining after the extraction of the teeth. 4. Perialveolar abscesses, remaining *in situ* and discharging through fistulas. 5. Residual areas of infection remaining unregenerated.

He recommends that all broken-off root fragments be removed, if they can be approached without a sacrifice of too much overlying structure. He continues:

> Many of these have no pathologic aspect and perhaps never may; but as the roentgenogram cannot be an index of this, the only safe procedure is their elimination when possible. If pathologic areas are present, the removal of this oleaginous infected bone is imperative, calling for a thorough curettage of the infected area.

Boyd S. Gardner, of the Mayo Clinic, reported that of 10,000 patients examined in one year, one-third of those who had extractions had retained roots.

Nodine[3] quotes statistics from the same source:

> At the Mayo Clinic examinations of the patients disclose that 87 per cent have infected teeth, and 80 per cent have pyorrhea. About 78 per cent of the patients at the age of 26 have lost a part of the jaw bone as the result of alveolar abscess. About 33 per cent have roots left in after the ordinary method of extraction. About 15 to 19 per cent have impacted or unerupted teeth. About 5 to 10 per cent have residual areas of infection.

Gardner[4] says:

> Focal infection should be of interest to every dentist, since practically every branch of dentistry deals with it, directly or indirectly. Even the prosthodontist should exercise care in seeing that the denture does not cover a hidden root or residual area of infection.

Wisoff[5] writes:

> By overlooking those parts of the mandible and maxillae that have previously been occupied by teeth, the patient is not receiving the proper diagnosis.

Miller[6] writes:

> In the building of full dentures, to the many records . . . should be added a complete set of oral roentgenograms, inspection of which will disclose remaining root particles, unerupted teeth, areas of residual infection, cysts. . . .

MacCallan[7] states that "buried root fragments of previously extracted teeth

very frequently give rise to toxic absorption" and "residual sepsis or bone infection may be indicated in a dental radiograph and may be confirmed when operation is undertaken to scrape away the diseased area."

McCall[8] writes:

The subject of residual infection is an extremely important one. An important point in diagnosis is this, that, in many of these cases, the tissue which in the roentgenogram would seem liable to show the most profound inflammation showed a very mild reaction or no reaction at all, and, on the other hand, cases in which the roentgen rays revealed comparatively slight variation from the normal frequently showed the most severe forms of inflammation when examined under the microscope. This indicates that we must, in making diagnoses for focal infection cases, and, for that matter, in the case of healthy people who might later develop focal infection, examine with just as great care the portion of the roentgenogram which covers edentulous areas as we give to that in which the teeth are still in place.

In the matter of case histories, I found four that mentioned retained roots as the cause of focal infection, five that cited impacted teeth and one that cited a residual area; all in edentulous mouths. I did not find any case histories relating to cysts or abscesses draining through fistulas.

Ray[9] reports the following:

A woman, aged 46, married, complained of a generally weakened condition and a very tired feeling by afternoon, was losing weight and experienced palpitation of the heart. The lower teeth were to be roentgenographed. It was suggested that the edentulous maxilla be roentgenographed, even though the teeth were extracted about ten years before. Roentgenographic findings showed imbedded roots in the maxilla. Of course, the patient could not believe this until the roots were removed. In ten days, a marked improvement was noticed, in three months a gain in weight of 6 pounds occurred and the patient was feeling much better.

Tenner[10] reports the following:

A woman, aged 65, had been treated for three months for a uveitis by a prominent ophthalmologist who believed the source of her trouble was gastro-intestinal and had referred her to a specialist in these diseases. When she came to me, I found chronic uveitis with a few deposits of Descemet's membrane, a large posterior synchysis and dense opacities in the vitreous. Everything was negative except for her oral cavity, and this was not very suspicious as she had only four teeth left, all lower, and had been wearing a plate of uppers for years. However, an x-ray showed retained roots (four in number) in her upper jaw, which were extracted after incision. Forty-eight hours after the operation the spots of Descemet's membrane disappeared completely, the posterior synchysis lessened in size and eventually disappeared. The floating opacities of the vitreous remained, however, resisting treatment. I feel certain that the long delay of at least three months accounted for this and that had the oral treatment been instituted at the inception of her uveitis, the floating opacities of the vitreous would also have disappeared.

Ellett[11] writes:

The usual treatment made little impression on the eye, and because he had had all his teeth extracted, the possibility of trouble in that direction was not at first seriously considered. May 28, the mouth was roentgenographed, and a root with a granuloma at one end was found embedded in the gum, having evidently been broken off in the removal of the tooth. This was at once removed. In two days, the eye was much better.

Suckling and Martin[12] write:

The eyes felt as if full of sand on waking. The patient had been in poor health for two months. Shortly a swelling in the submaxillary region developed, with septicemia, edema of the face and acute conjunctivitis. The patient was hospitalized for fifteen months, receiving every possible local treatment including vaccine from streptococcus

and staphylococcus obtained from the eyes, silver nitrate and ray treatments, with no result. Vision was lost. The cornea was hazy with small ulcers. A slight swelling appeared in the upper cuspid region. Roentgenograms of the apparently edentulous jaws were made, disclosing an impacted cuspid and root fragments. These were removed. A severe reaction followed for ten days, the eye condition becoming acute. Recovery was gradual of both the eyes and general health.

Chaim,[13] a German dentist, presents a case of Ludwig's angina caused by retention of a mandibular molar, with a temperature of 104 and a pulse of 120. The tooth had to be removed by an external incision at the angle of the jaw.

Ray [14] tells of a young married woman who wore an upper denture and who complained of frequent and severe headaches. Sinus treatment was of no avail. Roentgen-ray examination revealed four embedded teeth "hidden away under the floor of the naris and maxilla." When these were removed, the patient recovered rapidly.

Main[15] cites two cases, one, in a man, aged about 50. The removal of an embedded cuspid in an otherwise edentulous mouth gave almost complete relief from headaches. Another patient, aged 44, was relieved of headache by the removal of supernumerary teeth, one of which seemed to be directly in the anterior palatine foramen.

A case that, while having no connection with focal infection, is still interesting was reported by Hodgin[16]: A man, aged 28, had all his teeth removed and full dentures made. Four months later, he returned with a toothache and, on roentgen-ray examination of both jaws, a total of twenty-eight supernumerary teeth were found. This shows how much it is possible to hide under two full dentures.

Nyman [17] presents the following:

Mrs. M. N. suffered for a period of about two years with a distressing eczema, with frequently recurring exacerbations of the acute herpes type. Classical treatment failing to give relief, the case was referred to me for examination for possible focal infection in the mouth. In the lower jaw there were but six incisors remaining, all of which were vital. The edentulous regions gave no striking indications of osteomyelitis on macroscopic examination, but radiographic examination disclosed probable osteomyelitis of the upper right jaw and the lower left jaw. The patient gave a clinical history of removal of teeth in these regions "because of blind abscesses at the ends of the roots" some two years previously, and, in responding to questions, said that they had just been extracted, that her skin was better for a while but then grew just as bad again, "so it wasn't the teeth that caused it."

Operation disclosed a definite osteomyelitis with granulomas in both regions worse than the radiograms suggested. Curettement and postoperative treatment was carried on for ten days, and all systemic treatment was suspended save mild topical applications to eczematous areas. In approximately three weeks, the skin condition completely cleared, and there has been no recurrence for over a year.

Cole[18] presents a case in which two upper teeth were removed in an effort to give relief from the pain of tic douloureux. This failing, the entire mouth was roentgenographed and two areas of residual infection were found in the edentulous lower jaw. When these areas were chiseled out, the pain was relieved. Pus taken from one area showed *Staphylococcus aureus*. From the manner of recovery, and since this germ is capable of producing pressure, it is concluded that the presence of this area had caused the tic.

After a review of these cases, two conclusions seem inevitable. 1. The edentulous mouth is a factor in focal infection that should never be overlooked. 2. The scarcity of definite literature on the sub-

ject indicates that it has not received the attention that it deserves.

Austin and Stafne,[19] of the Mayo Clinic, say that today they find fewer cases of broken-off roots and residual infection than formerly. This, they assert, is due to the increasing use of the roentgen rays and to better dental practice. They insist that all of these rarefied areas of residual infection should be explored and their contents removed. Only a small percentage will be found to be infected, the remainder containing fatty tissue. This fatty tissue should be sent to a pathologic laboratory for examination, for a large percentage is found to be small tumors.

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CAST PREPARATION FOR IMMEDIATE RESTORATIONS*

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OSSEOUS structures that are to act as a support in the restoration designed to bring the broken arch back to normal and to produce an efficient unit of mastication are of vital interest to the prosthodontist. Since the dental conditions are not of our own making and the skeletal framework upon which we are to build a superstructure is, usually, not favorable to the burden that is soon to be placed upon it, all designs and application of engineering principles should at all times submit to the primary objective: preserving the osseous base just as long as possible.

The removal of the natural teeth need not entail the loss of any of their supporting framework unless pathologic conditions dictate such removal, or when it becomes desirable to change the contours of the lower third of the face for esthetic reasons. The ardent supporters of alveolectomy may contend that removal of bony structures is necessary in practically every case wherein the extracted teeth are to be replaced immediately by artificial dentures.

The operator should have a clear vision or conception of the final results of alveolectomy and "surgical removal" of the teeth before he decides on the operation. His judgment must be based upon clinical data, roentgenographic evidence, the mechanical problems which are involved and the general health of the patient. Most of the present-day literature on the subject of osseous tissue conservation lays stress on the elimination of trauma by means of mechanical detail or procedures without giving the other factors the consideration which they deserve.

The evils that attend alveolar resorption are known to every prosthodontist, who quite frequently accepts them as inevitable, preparing the patient for the worst and thus relieving himself of the attending responsibilities. The patient does not understand why the foundation for the denture restoration should be considered as shifting sand when in reality it is very much like real bone. He does not understand why the balanced maxillary and mandibular dentures do not retain this relationship for an indefinite period and resents the operator's request to have one or both dentures remade every two or three years. He cannot be expected to understand the structural changes that take place in the ridges after the teeth have been removed or the cancellated nature of the substructure upon which the dentures are to rest. He can understand that every bone structure has an outer layer or cortical section of the bony support, which is denser and more able to support the dentures.

The operator's responsibility lies in two directions: He should plan the details of the restoration to conserve the maximum amount of cortical bone structure consistent with the esthetics of the case; and he must prepare a suitable foun-

*Read before the Section on Partial Denture Prosthesis at the Seventy-Eighth Annual Session of the American Dental Association, San Francisco, Calif., July 15, 1936.

dation for the restoration without invoking the destructive influences of mechanical stress, and yet permit the wholesome stimulation of functional stress and thus seat the dentures more firmly in contact with the supporting tissues.

Every prosthodontist and most dentists who have practiced a few years have noted the variable response of the osseous base to the pressure of the prosthesis that rests upon it. This reaction, favorable or unfavorable, is either credited to or blamed on the nature of the material from which the prosthesis is fabricated. Should the restoration be of gold, with the result that there was very little change in the osseous base, the conclusion usually would dictate the use of that metal for all restorations. I usually use vulcanite for the first denture and for immediate restoration, this denture being later replaced by one made from metal or a combination of metal and other materials. Certain patients never have the change made, but continue to wear the vulcanite with comfort and maintain a

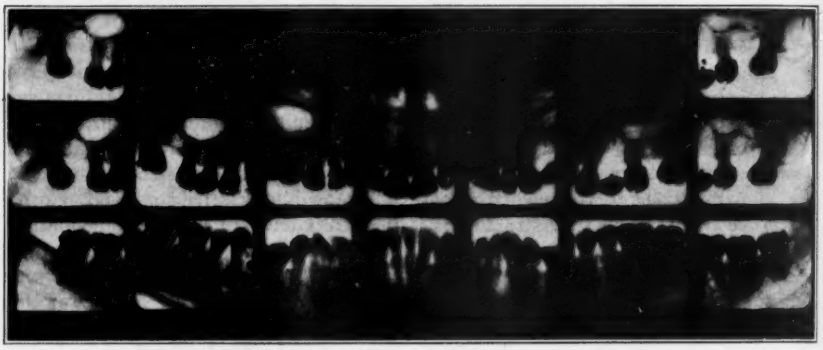

Fig. 1.—Case showing thin and frail osseous structure supporting teeth. Such cases require the minimum set back carving for the anterior teeth.

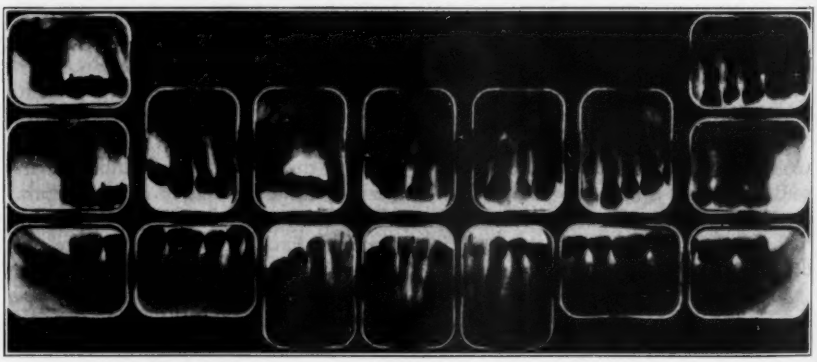

Fig. 2.—Case showing heavier and denser osseous structure supporting teeth. (Compare Figure 1.) This condition requires a greater set back carving for the anterior teeth.

stable condition of the supporting structures. The primary aim should ever be the conservation of the cortical layer of the bony support upon which the prosthesis will rest. If the cortical layer is thin and weak, the underlying cancellated structure will be unable to sustain the load placed upon the surface. The stress area of the restoration may then be increased within reasonable limits to compensate, or the direction of the stress may be shifted to permit the force of the occlusal impact to fall at right angles to the base of the prosthesis.

The operator must be mindful of the fact that most of the patients who have to wear partial dentures are potential full denture patients; and he should, therefore, plan the details of construction in a manner that will aid and not hinder in the constructing and wearing of a full denture. It may be his lot to care for the patient when that time arrives and he will have to compensate for the difficulties that have been brought about by functional stresses and attending tissue reactions, which were the result of faulty engineering.

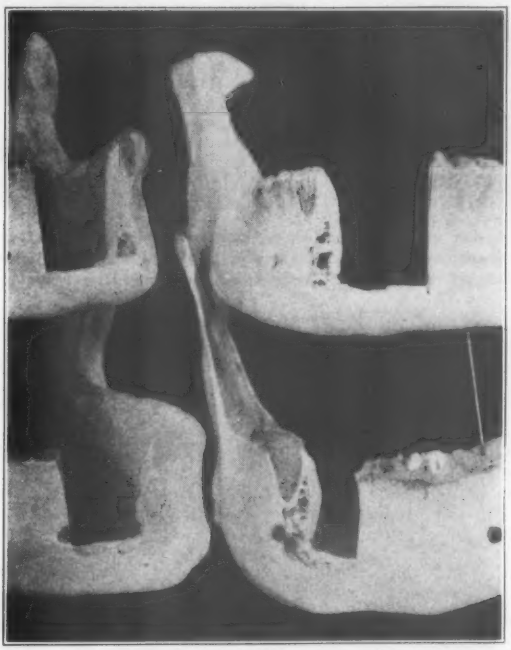

Fig. 3.—Sections of mandibles showing heavy lingual wall and frail labial wall. The carving of the cast from such a condition requires a minimum set back for the anterior teeth.

A partial denture may be made either a tooth-bearing or a tissue-bearing appliance or a combination of both. The latter exists only for a short time and soon becomes a tooth-bearing partial denture. If the stops should break, the restoration becomes a tissue-bearing appliance. This does not imply that the alveolar process

is always an unstable factor in denture support. The problem is: Can we construct and adapt an appliance that will function as a satisfactory masticating unit and yet maintain a stable condition of the alveolar process of either or both of the arches? I have found this quite possible; but, in order to accomplish it, we must have the full cooperation of the patient and the exodontist. Surgical operations on the osseous tissues of the mouth and the removal of the teeth must be performed with the idea of alveolar process conservation and of allowing Nature to do the thing that man can never hope to do. Alveolotomy and its attending evils have

Fig. 4.—Cross-section of four mandibles between second bicuspid and first molar showing four types of structures and density. The cast in this area and points distad from it should be carved very sparingly to conserve all the possible bony support.

Fig. 5.—Section in first molar region showing structures that do not make good denture bases. Such cases will require the carving of the cast toward the grinding surface of the teeth, but not in the lateral areas.

done much toward the ruination of denture foundations, either full or partial. The removal of sharp spines and spiculae is advised, if they can be removed without destroying the existing band of tissue that connects the labial and lingual mucosa. These may be removed by the careful use of instruments designed for the purpose. Thus, there will be no occasion for suturing and its accompaniment, a scar tissue septum.

Removal of the labial plate of the alveolar process is seldom indicated, and a slow transition of contours in the lower one-third of the face is more desirable than a radical change produced by surgical means and its attending evils. It is well to remember that the healthy cortical layer of the process should be retained if it is at all possible and that the periosteum is limited in its bone building powers after it is stripped from the cortical layer and stretched over a newly prepared

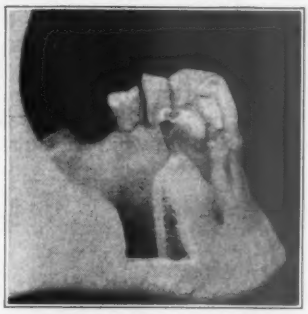

Fig. 6.—Cross-section showing well-developed ridge with strong buccal and lingual wall.

Fig. 7.—Cross-section of area shown in Figure 6, but in bicuspid area.

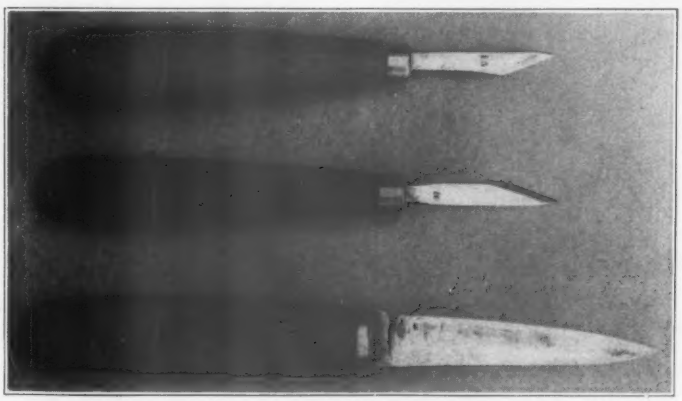

Fig. 8.—Required equipment consisting of right and left laboratory chisel with long bevel. A Swedish harness knife makes an excellent tool for general carving if the blade has a long point.

cancellous base. I have found that the cases that suffered radical surgical treatment required repeated rebasing or remaking of the dentures and were very unsatisfactory because the osseous base was undergoing continuous resorption.

I fully realize that there are cases in which conservation of the osseous base seems impossible and that the conditions that affect the stability of the alveolar process appear to be beyond our power to control. There are many partial denture cases in which the ridges have suffered very little from the stress of occlusion in either of the two arches. Also, there are those that do not sustain even the lightest load if the pressure is continuous. The difficulty in these cases can be traced to incorrect diet and faulty metabolism, and, when these are corrected, the osseous condition will also clear up. There remains the influence of functional stress and its localized effect in the older patients, who do not respond to treatment so readily as the younger patient. Therefore, the mechanical forces that militate against our efforts must be conquered and directed to function in our favor.

The structures of the maxillary arch vary greatly in density, blood supply and stability from those of the mandible and offer the most satisfactory denture support. This, in part, is due to the presence of a more or less uniform cushion of soft tissue over a firm labial and buccal shoulder of cortical bone, which gives the necessary support for the various restorations. If these buccal and labial layers of cortical bone are removed by surgical means, the cancellous structure suffers more from resorption than in those cases wherein Nature is allowed to build the ridge after the teeth have been removed and only a minimum amount of curettement takes place.

Fig. 9.—Normal central incisor in normal surroundings.

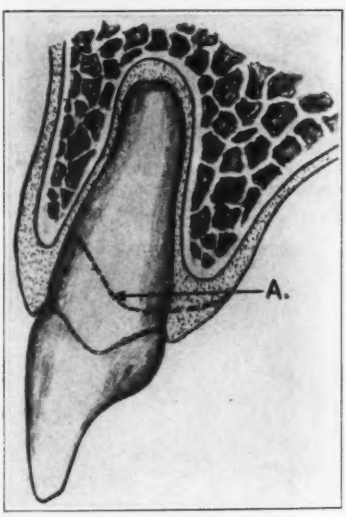

Fig. 10.—Drawing of tooth in Figure 9. *A*, depth and area of proposed carving of cast for extreme cases.

I have been compelled to conclude that extensive removal of cortical bone is contraindicated in practically every case; that even the short protruding arch and heavy ridge, in the case wherein the patient shows all of the labial surfaces of the teeth and a goodly portion of the ridge tissues when smiling, should not be treated by surgical methods, but rather, by allowing Nature to do her work under the gentle pressure and tissue exercise of a normally fitting partial denture. The cast upon which the appliance is built may be prepared in a manner that will permit the development of a firm foundation for the restoration, while Nature makes a slow change in the labial contours of either or both arches. It is unfortunate that the operator is not able to build the case, observe it for a time and later arrive at conclusions that are supported by clinical observation and corroborated by postmortem observation findings. I can recall many cases wherein excessive protrusion was reduced by the slow, natural method of resorption, with pleasing and satisfactory results. The patient and family were not embarrassed by sudden physical changes because the physiologic change requires several months for completion. Consequently, the final results are not so radical, and the changes that do take place still enable the patient to maintain the family characteristics. Most patients do not look forward eagerly to a radical change in facial outline. While they may not feel well pleased with conditions as they are, they prefer to remain as they are unless

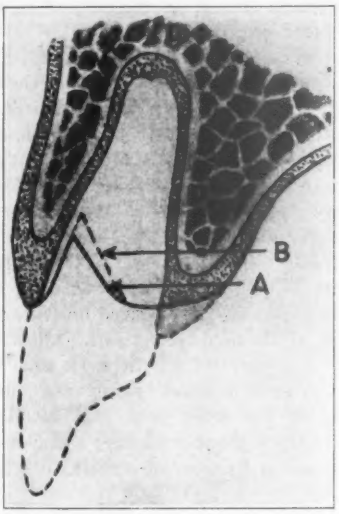

Fig. 11.—Proposed position (shown by dotted line) of supplied vulcanite tooth in cases having weak alveolar ridge. The proposed position of the vulcanite tooth in those cases which have a firm, dense alveolar ridge is indicated by the solid line.

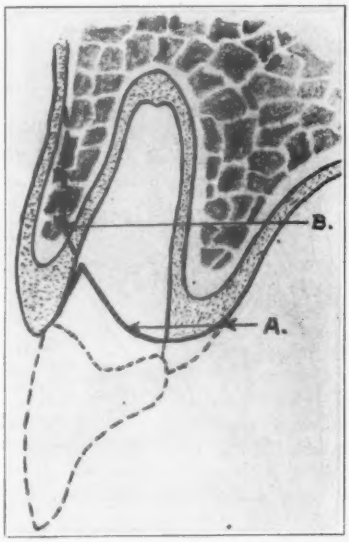

Fig. 12.—Carving required in addition to that necessary for open-face denture work. If alveolectomy is indicated, the carving shown by *A* is extended as shown by the broken line (*B*).

a slow change, which preserves the individuality, can be instituted. The degree of change and the rapidity with which it takes place depend on the structure of the bone, the health of the patient, functional stress and the operator's ability to handle the mechanical details that are involved in the restoration.

The roentgen-ray picture of the structure supporting the teeth is the best means for determining the density and amount of bone surrounding the teeth and thus guiding the operator in determining the

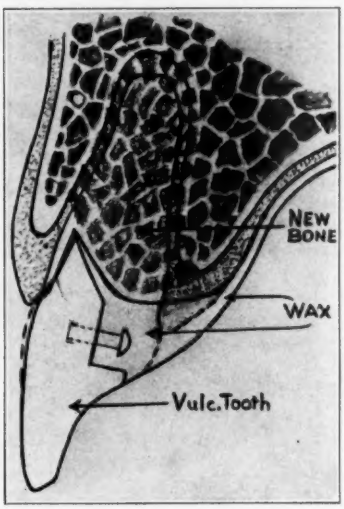

Fig. 13.—Details of arranging and waxing open-face immediate dentures.

labiolingual location of the proposed socket of the supplied teeth and the depth to which the socket may be carved. The cases that have a heavy dense labial plate require a shallow socket placed a little more toward the lingual aspect than the position of the natural tooth that is being replaced. The cases that have a light, thin labial plate will require a deep socket placed in line with the neighboring teeth and as nearly as possible in the location of the tooth that is being replaced. The other cases, which can be classified between these two extremes, are trimmed in a similar manner by the cutting of the socket more lingually for the cases with denser osseous structure and not quite so deep. If the case has had some teeth removed several years before, the degree of resorption, as may be seen on the cast, will give the operator a guide for trimming in the new area. The general contour of the ridge in the area of complete resorption should be maintained in the proposed denture area.

The cast should be poured with two separate mixes of stone. Some of the artificial stone may be reduced in hardness by the addition of a good cast plaster. The proportions may be varied to suit the operator's hand for carving. I prefer a fifty-fifty mixture for the tooth area of the impression, filling the remainder of the impression with the full strength stone. These mixes may be made at the same time and then poured one into the other while they are yet soft. The fifty-fifty mix may fill a little more than the tooth area without doing any harm because the stone mix will blend in perfectly without producing a line of demarcation. Such a cast is more easily prepared for the immediate restoration because the tooth and gingival areas are not so hard as the remainder of the cast.

The case is then mounted on an adjustable anatomic articulator and all the instrument adjustments are made according to the functional requirements of the case. This must be done before any teeth are removed from the cast or casts.

The teeth that are to be removed are then marked with an indelible pencil, to insure against a mistake being made, and separated from the other members of the arch with the mechanical saw. The cutting is done at the expense of the teeth

that are to be removed and deep enough to permit fracturing at the point where the tooth joins the cast. This will leave a line showing the labial or buccal surface of the tooth and a guide line for that surface of the socket. The socket is cut with a laboratory chisel that has been ground with a long tapering bevel or with a laboratory knife that has a blade with a long, tapering point. The labial or buccal line of the socket is placed 1 mm. lingually toward the natural line for the cases with a thin cortical plate, 2 mm. for the average case, and 3 mm. for the cases with a heavy dense cortical outer plate of bone. The labial contour of the proposed socket should be similar to the surface of a ridge contour if it is present. In the absence of such a guide, the ridge lap of the average vulcanite tooth will serve the purpose. The general slope of this triangular socket should be in line with the long axis of the tooth (or teeth) that is to be removed and replaced with the prosthesis.

Sometimes, the operator is tempted to make a confluent preparation when there are two or more adjoining teeth to be replaced. This should be avoided in all areas except in the anterior or labial area of the mandibular cast, and even there the individual preparation would be more desirable. If this area has been prepared in the confluent outline without individualizing each tooth, a pencil outline for each tooth in the replacement should be made for a labial-lingual guide for the waxing of the case and to prevent any teeth from straddling septal tissues and to permit each supplied tooth to enter the socket of its natural predecessor.

The socket preparation may be used for all the teeth in the arches, even including the molars, unless the operator desires to obtain the added support of a buccal wall in the molar region. Such cases do not require a socket for the molars, and the teeth are trimmed flush with the general contour of the cast, the buccal walls of the cast being undisturbed in the areas of the three molars. The wisdom of the foregoing principles and technic are shown in the following two cases:

REPORT OF CASES

CASE 1.—Mrs. W. was referred for a full maxillary and mandibular restoration and elimination of six granulomas and a number of areas that were affected by periodontoclasia. The general condition was poor and the dentures were poorly constructed and a real menace. The two dentures were constructed on casts that were prepared in harmony with the principles outlined in this paper. The patient was taken to the office of an exodontist, who removed all the bridges and remaining teeth in the maxillary arch under nitrous oxide anesthesia. The prosthesis was placed in the mouth and the patient was dismissed with the usual instructions regarding the care of the mouth and of the denture.

The extraction appointment for the next week was broken because some social appointments demanded the patient's time, and it was not until four years later that she returned for an appointment to have the mandibular area cleared of the areas of infection. The same oral surgeon took care of the surgical work and I placed in position the denture that had been made four years previously. The patient has enjoyed the maxillary restorations for the past four years and eight months and the mandibular restoration for the past eight months, strange as it may seem.

CASE 2.—A widow, aged 38, who suffered from arthritis and a heart lesion caused by mandibular multiple granuloma (eight lesions) and an advanced state of periodontoclasia, had a maxillary arch made up of nine teeth, some of which supported two bridges. Her physician recommended the extraction of all the teeth.

I prepared the casts and constructed the two dentures eight years and four months ago, at which time the mandibular teeth

were removed under procaine anesthesia and the denture was placed in position. The patient's general condition improved greatly and she delayed the extraction of the maxillary teeth until May of this year. She neglected the maxillary teeth during this time because they were to be removed anyway, saying that she was going to get as much "mileage" out of them as possible before she let them go.

The time for the removal of the bridges and the teeth arrived. The operation was performed under procaine, and the denture, which was made eight years and four months previously, was inserted. The patient is now wearing both dentures, though she has worn the mandibular plate continuously for the past eight years.

These two cases are not the most outstanding from the point of time. I have two men who were taken care of nine years ago and a woman who is wearing two immediate partial dentures that were placed in her mouth over twelve years ago. These six are still the original dentures. Therefore, I feel justified in recommending the foregoing principles and technic for your consideration.

832 Pacific Mutual Building.

THE STRATEGY OF ORTHODONTIC TREATMENT

By SPENCER R. ATKINSON, D.D.S., M.D.Sc., Pasadena, Calif.

THE most successful general is not necessarily the one who can develop the best equipped and best drilled army, but the one who, having developed an army, has the ability to use it with the least loss and with the greatest dispatch and effectiveness, to accomplish his objectives. A small force used with expert strategy is more effective than a much greater force bunglingly handled. Military strategy must be based upon the general's knowledge of the opposing forces and the terrain in which the action is to take place, and upon a clear conception of the ability and limitations of his own forces.

Just so in orthodontics, the most successful practitioner is not necessarily the one most expert in wire manipulation and the building up of appliances, but the one who, having developed a mastery of the mechanics of applying therapeutic force, has the ability to use it with the least amount of disturbance and with greatest dispatch and effectiveness to accomplish his objectives.

With expert strategy, the use of extremely delicate appliances is more effective than a heavier application of brute force. Strategy in orthodontics must be based upon a knowledge of the mechanics and biologic factors of the malocclusion and of the terrain in which the orthodontic operations must take place, and upon a clear conception of the possibilities and limitations of the tissues involved and the appliances to be used.

The first dictate of orthodontic strategy is to recognize and remove the etiologic or correctible factors of the malocclusion to be treated. Foremost is the abnormally soft bone of calcium deficiency present in varying degrees in so many cases. Whether the underlying cause is nutritional or vitamin deficiency or endocrine control of utilization, it should be ferreted out and corrected. In some cases, this factor is so exaggerated

and impossible of correction that any orthodontic campaign is foredoomed to tragic failure.

The other etiologic factors fall naturally into two classifications: those which cause mass malocclusion involving the entire denture and its position in the skull and those which cause localized or regional malocclusion. Mass and regional malocclusion calls for entirely distinct strategy as regards both the control of etiologic factors and the case treatment.

MASS MALOCCLUSION

Most mass malocclusion, barring those

Fig. 1.—Leaning posture which causes mandibular retrusion and deep overbite owing to intrusion of the posterior teeth. The cuspids may erupt high on the labial walls of the maxillae.

cases which, in our present meager knowledge, we class as hereditary, has two causes. One is the derangement of the balance of atmospheric and muscle pressure under the guidance of which the growing jaws and erupting dentures develop. The other is some extraneous pressure. The degree of malocclusion resulting from a given extraneous factor will be in direct ratio to the softness of the supporting bone.

Derangement of the balance of atmospheric and muscle pressure is caused by mouth breathing. It has long been conceded that orthodontic treatment cannot be wholly successful unless this etiologic factor is eliminated.

An extraneous pressure which may cause mass malocclusion results from sleeping on the abdomen with the weight of the head resting on the face and jaw. This pressure may be unilateral or alternately bilateral and, in the latter case, the upper arch may be so constricted that the tongue cannot occupy its accustomed position in the palate, with the result that

Fig. 2.—Pressure against developing bicuspid buds, causing resorption of distal roots of deciduous molars. Development of the body of the mandible is impeded by the pressure of a retrusive leaning habit. The upper denture continues its normal forward growth and, through interaction of the upper and lower cuspal planes, the lower denture is carried forward in relation to its apical base.

the vacuum normally produced is lacking, with a deranged balance of atmospheric pressure. Mouth breathing may become secondary factors in these cases.

Some leaning habits in which one or both sides of the face may be rested in the palm of the hand have the same result. Strategy demands the prompt elim-

ination of such extraneous pressure, which may amount to as much as 10 or 15 pounds, in order that the therapeutic pressure exerted by the appliances and ranging from one-half to 4 ounces may be immediately effective. If the extraneous pressure is not eliminated, excessive force must be applied to the teeth; treatment will be greatly prolonged, and there will be greater likelihood of root resorption in borderline mineral deficiency cases and the certainty of prompt relapse of the case after treatment is completed.

Fig. 3.—Bone dissection showing actual condition indicated in roentgenogram shown in Figure 2.

Many orthodontic relapses could be prevented if orthodontists would take more cognizance of these sleeping and leaning habits. One has only to observe the prevalence of leaning habits among the children visiting any busy orthodontic clinic, and note the relation of the various types of posture pressure to corresponding malocclusion, to appreciate the necessity of eliminating this factor if the treatment is to be successful. Any orthodontist who will carefully check his records will find that the relapsed cases are, almost without exception, the ones in which leaning or sleeping habits have persisted.

There are three types of mass malocclusion recognized and classified by Edward H. Angle. The first is that in which the jaws are in correct mesiodistal relation to each other, but the arches are constricted or the teeth are otherwise out of alinement. In the other two classifications, the jaws are out of normal mesiodistal relationship to each other.

Fig. 4.—Leaning posture which causes constriction of upper arch, pronounced overbite and overjet and underdevelopment of mandible.

One important and dependable aid to the diagnosis of the mesiodistal relationship is the key ridge, which I first mentioned in 1923. This strong ridge of

bone projects downward from the anterior end of the zygomatic arch and normally extends over the mesiobuccal root of the upper first permanent molar. At 3 years of age, the mesiobuccal root of the second deciduous molar is under the key ridge and the upper first permanent molar is developing in the jugal buttress posterior to it. As the denture develops, the permanent first molar moves forward, and at the age of 18, it takes its place under the key ridge. The key ridge remains constant to the bones of the cranium throughout life, regardless of

If the buccal teeth of the upper denture have drifted forward from their normal position, the upper first molars will be anterior to the key ridge and their mesiobuccal roots will project, partly denuded of bone, into the canine fossa. Should the molars be left in this position and the teeth anterior to them be moved outward to arch alinement, they will be moved beyond the ability of the labial cortical plate to reorganize and their roots also will be denuded of bone. Facial balance will be upset, the patient will have a "toothy" appearance, the

Fig. 5.—Effect of pressure on developing bone as shown in Indian skulls. The Pueblo Indians tied their papooses to boards to produce the square shape of the head that they admired. For the same reason, Flathead Indians applied pressure by means of a slab of bone or wood to the tops of babies' heads. Whereas, the Indians warped the head bones intentionally, modern Americans warp their faces and jaws unintentionally by certain leaning and sleeping postures assumed in childhood. The early breaking of such habits would prevent not only facial and dental deformity, but also handicapping of the chewing function, a great deal of the caries and pyorrhea of later life and many cases of general ill health.

race or type, and regardless of what happens to the teeth or alveolar process. Moreover, it is found true to form in all mammals.

Determination of the position of the upper denture in relation to the key ridge has a most important bearing on the strategy of treatment.

dentures will be in double protrusion and the teeth will have a precarious future owing to deficiency in their bony support.

If the forward relationship of the molars is recognized, these teeth may readily be retruded through the cancellous bone lying between the lingual and buccal

cortical plates. Normal cancellous bone is rich in marrow and has the abundant circulation desirable for facile bone change.

Changes in dense cortical bone call for difficult histologic rearrangement and for the resorption and deposition of much larger amounts of calcium than are required for tooth movement in cancellous bone.

In the case having a protruded upper denture and a narrow upper arch, good strategy demands that the lateral segments be retruded through cancellous bone, between the lingual and buccal cortical plates, with the lower denture as anchorage. Owing to the divergence of the lateral segments of the arch, the diameter between the lateral halves increases as we go posteriorly. The arch diameter at the first molars may be at least 4 or 5 mm. wider than at the second bicuspids. When the second bicuspids are moved backward to their normal position, now occupied by the first molars, they will automatically gain in width. Arch wires, regardless of type, must be widened as the buccal teeth move posteriorly, to permit of this expansion and keep the teeth in the channel of cancellous bone between the cortical plates.

When the dentures are already in proper relation to the key ridge, the anterior and bicuspid teeth may be moved outward to arch form, in the belief that bony support will be built up around them. When the dentures are anterior to normal key ridge relationship, the anterior and bicuspid teeth will be moved out beyond the normal support of the facial bones. There is liable to be a lack of labial bony covering of the roots and a recession of the labial gum.

The first step, then, in the treatment

Fig. 6.—Transverse cross-section through maxilla showing zygomatic process (*a*) and key ridge (*b*) descending to mesiodistal root of maxillary first molar (*c*).

Fig. 7.—Horizontal section of maxilla showing key ridge (*a*), with mesiobuccal root (*b*) of molar at its base; *c*, distobuccal root; *d*, lingual root. The thick buccal cortical plate adjoins the molar root and there is cancellous bone between the cortical plates. A broad buttress of bone supports the molars.

of protrusions of the upper denture is to carry the upper molars back to their normal position in relation to the key ridge and then to aline the anterior portion of the arch. While the lateral segments of the arch are being retruded, the anterior teeth, freed of pressure from behind, will tend to correct themselves. When the lateral segments have reached their proper position, the anterior teeth are banded and moved to arch alinement with surprising ease and safety. Moreover, bands are required only on the anterior teeth during this brief, latter stage of treatment.

Fig. 8.—Denture at 3 years. The mesiobuccal root of the deciduous second molar is under the key ridge. As the jaws develop, the dentures move forward, downward and outward.

There are three important additional points of strategy for the treatment of mass malocclusion. The first relates to cases in which the upper denture is in normal skull relationship as indicated by the key ridge, but the mandible is diminutive and the lower denture is posterior to the upper.

It is desirable in such cases to induce growth of the entire mandible without dragging the lower teeth forward in relation to their apical base. It is essential that any extraneous pressure of sleeping or leaning habits should be promptly eliminated. There is then a normal impulse for forward growth of the mandible, which is further stimulated by force derived from the pull of the customary intermaxillary elastics. Although the upper denture is in normal skull relationship, it is desirable, in these cases, to retrude it somewhat, thus lessening the distance the lower denture must travel to reach cuspal interdigitation. There is ample room and entire safety for the upper molars in a position posterior to normal; but any considerable

Fig. 9.—Skull of Australian Bushman. In the prognathous or protrusive type of face, the curvatures of tooth roots and key ridge are harmonious.

forward movement of the lower teeth is a menace.

In these cases, the retrusion of the upper denture is accomplished by moving the lateral segments of the arch first, after which the anterior teeth are readily retruded. Thus, excessive or too prolonged application of intermaxillary force to the lower denture is avoided, and there is less likelihood of permitting the lower denture to skid forward upon its apical base.

The second point of strategy in mass

malocclusion relates to the recent and unfortunate belief that the buccal teeth can be tipped posteriorly from their apices. For a long period, orthodontic appliances were not capable of moving the apices of teeth buccally. The belief grew that the apices of teeth were difficult to move—that they offered a stable anchorage. This is fallacious.

The crest of the interproximal bone between each two teeth consists more or less of a dense bridge of cortical bone. From this transverse bridge downward to the apices of the roots, the interproximal bone becomes more and more cancellous. This bridge or crest of interproximal bone therefore acts as a fulcrum. The tooth is not tipped from its apex, but is swung upon this fulcrum, the root moving in an opposite direction from the crown and to a much greater distance.

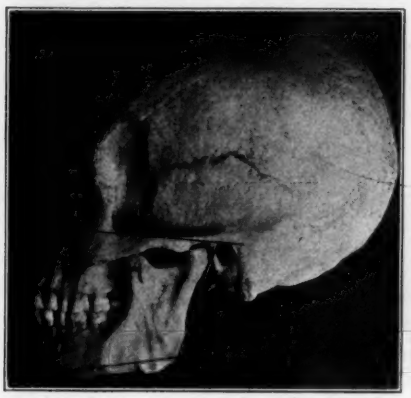

Fig. 10.—Protrusive type exemplified in contemporary Mexican skull. According to the orbital plane of Simon, the dentures would be in protrusion. This, as in Figure 9, is a racial characteristic and the key ridge shows the dentures to be normally oriented in the skull. These skulls verify Simon's statement that the relationship between the orbital plane and the dentures varies with the facial type. (Courtesy of David W. McLean.)

The third point of strategy for mass malocclusion applies when either arch is anterior to its normal skull relationship. The protruded arch is always moved back in segments, the entire opposite arch being used as anchorage.

It is the natural tendency of the dentures to drift forward. A denture which is being retruded is moving against that natural force, while the denture used as anchorage has both the elastics and this natural urge tending to move it anteriorly. In addition to this fact, it is always good policy to unify an anchorage denture and break up into smaller segments the denture to be moved.

Fig. 11.—Edentulous skulls of childhood and advanced age, in which key ridge is distinctly indicated. Like the zygomatic bone itself, the key ridge remains a constant anatomic landmark throughout life, regardless of the presence or position of the teeth.

REGIONAL MALOCCLUSION

While heredity and the general physical condition play a rather conspicuous part in mass malocclusion, those cases of a regional nature are more often produced by direct influence on the localized area. The severity of the malocclusion depends on the condition of the supporting bone as well as on the nature of the activating factor.

Strange as it may seem, the most common cause of regional malocclusion is the most obvious one, but the most universally overlooked. It is the habit children have of resting chin or cheek upon their hands during those hours which they spend sitting down, whether at the seashore, in the mountains, at home, in the

Fig. 12.—Skull dentures in double protrusion. The denuded mesiobuccal root of the maxillary molar, anterior to the key ridge, projects into the canine fossa. Bicuspid, cuspid and incisor roots are partly denuded. The mandibular first molar is placed in bone too narrow to support and cover it. The anterior lower teeth are partly denuded of labial bone.

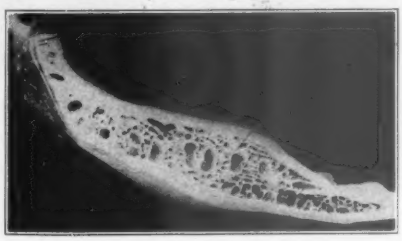

Fig. 13.—Horizontal section of mandible showing cancellous nature of bone lying between buccal and lingual cortical plates. The greater ease of moving teeth in the cancellous bone is readily visualized.

school or movies or elsewhere. Once formed, these habits are indulged almost constantly. The child may become so accustomed to this pressure that he will sleep with the hand under or pressing on his face.

This pressure on the face becomes so comfortable, and the malocclusion is brought about so slowly and painlessly, that it is often difficult to convince patients that such seemingly trivial habits

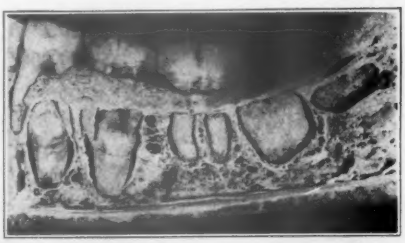

Fig. 14.—Dissection of mandible of child with mixed denture. If force were applied to tip the first molar distally on its apices, a fulcrum would be established by the dense transverse bridge at the crest of the interproximal bone distally from it. This fulcrum would be backed up by the developing second molar. The apices of the first molar would readily move mesially through cancellous bone.

Fig. 15.—Mandibular bone dissection showing transverse crestal bridge of interproximal bone and increasingly cancellous formation as the root apices are approached.

and such comfortable pressure could possibly cause so pronounced a deformity of bone, a substance which they think hard and rigid.

As a matter of fact, we all know that

from infancy to old age, bone is changing constantly and is always susceptible to the guidance or influence of pressure. The habit of standing on one foot may seem inconsequential, but, persisted in, this faulty posture will in time, through perverted and excessive pressures, produce spinal curvature, general deformity and interference with the functions of internal organs. It should have been more generally recognized long ago that local concentrated pressure on the bones of the face could and does cause deformity of these bones and malposition of the teeth which they carry.

Fig. 16.—Transverse vertical section of mandible in molar and bicuspid region, showing dense crest of interproximal bone and increasing porosity of deeper bone between buccal and lingual cortical plates.

The first requisite of treatment is the breaking of these leaning and sleeping habits. This calls for the cooperation of the patient. First of all, the patient must be convinced that these comfortable habits are really pernicious and are at the bottom of the deformity. Moreover, he must be convinced that if these habits are persisted in, the case will certainly relapse, and that time, effort and money will have been wasted.

For many years, I have made a practice of using the candid camera for recording and classifying postures assumed by patients while reading or otherwise relaxed. The manner of leaning is always definitely indicative of the resulting type of malposition. The person with a postural habit drops into the familiar, comfortable posture, on any occasion and in any circumstances. Photographs in newsprints and magazines abound in such postures. It is not surprising that even in the dental chair, and even knowing that a camera is pointed at him, and while he is therefore on guard, the patient will none-the-less relax his vigilance and drop into the accustomed pose.

Fig. 17.—Leaning posture that will cause deep anterior overbite, retrusion of incisors and mandibular retrusion (Angle's Class II, division 2).

The camera is focused on the dental chair and operated by push buttons located in various places about the office. Whenever a child is seen to assume a habit posture, a picture can be taken without giving him warning or time to change the position.

Other causes of regional malocclusion are, of course, premature loss of deciduous teeth, loss of contact points and mesiodistal tooth dimension through caries and absence of teeth. These causes have long since been recognized and, through the use of modern tooth restoration and space retainers, have come to be of minor significance in the clinical practice of orthodontics. Moreover, once the cases so caused are corrected, the etiologic factors are no longer operative. The leaning and sleeping habits, unless eliminated, remain active to combat treatment and cause relapse.

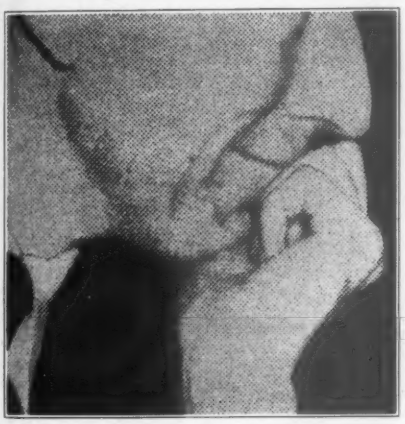

Fig. 18.—Counterpart of leaning habit shown in Figure 17, as seen in newspaper.

Orthodontists are prone to assume the responsibility for the lapse of cases, and often wonder what they could have done or left undone to cause the disappointing condition; when, as a matter of fact, it is some uncorrected extraneous pressure that is at fault. The patient has unwittingly or through lack of cooperation nullified all of the orthodontist's efforts.

DIAGNOSIS OF REGIONAL MALOCCLUSION

The first step in diagnosis in regional malocclusion is best made from the impressions before the casts are poured. Lateral pressure from leaning habits is not so liable to cause regional malocclusion in the mandibular arch, as the mandible can swing laterally and escape the pressure. In the maxillae, lateral leaning pressure cannot be escaped and the lateral segment on the affected side of the arch is moved toward the median raphé, forcing the hard palate upward and usually causing deflection of the nasal septum toward the opposite side or causing an s-curvature of the septum.

Fig. 19.—Regional malocclusion from excessive and perverted muscle pressure during deglutition resulting from presence of mutilated, obstructed or permanently anesthetized throat area.

In these cases, the upper denture impression will show one side of the hard palate to be higher than the other.

Both impression and cast aid greatly in diagnosing the position of the anterior teeth. The anterior portion of the hard palate may curve down normally to the anterior teeth; it may extend forward with a shallow curvature to teeth tilted forward and anterior to their rightful position; or it may curve downward abruptly to teeth that are retruded and perhaps tipped lingually.

These diagnostic factors may indicate the anterior teeth to be in proper position, while orientation to the key ridge may show one side of the upper denture and all of the lower to be correct. One lateral segment of the upper arch may have drifted forward, owing to absence of a tooth or the presence of a high cuspid or a clover leaf bicuspid or other misplaced tooth. Such a condition is classified therefore as a regional malocclusion.

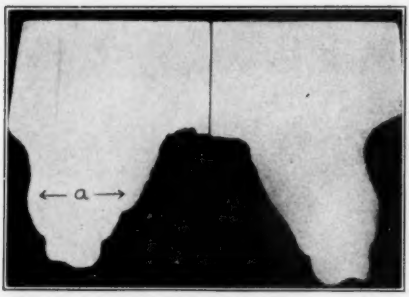

Fig. 20.—Cross-section of orthodontic study model showing one side of palate made abnormally high by upward and inward pressure on that side of face. As the posterior teeth are depressed, there is a buccolingual thickening of the supporting tissues.

In some cases of malocclusion, both sides of the dentures will be oriented correctly to the key ridge; which indicates that the condition is either a lateral mass malocclusion or a regional one.

The impression technic for showing the key ridge on orthodontic study models is simple. A rim of beeswax is built up on the labial and buccal periphery of the impression tray. The buccal wax is thin and extends upward far enough to take in the key ridge. The warm colloid impression material is placed in the tray and softens the periphery of beeswax. The impression thus obtained registers a well-defined key ridge. The same result may be obtained with modeling compound.

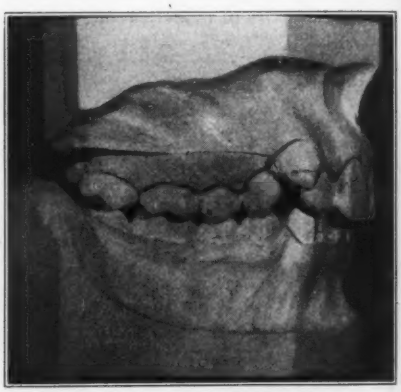

Fig. 21.—Cast of case in which cuspid and lateral incisor are displaced and buccal segment has drifted forward. The maxillary first molar should, at this patient's age, stand slightly posterior to the key ridge. To move all teeth to accommodate this misplaced buccal segment would carry the anterior teeth into or through the buccal cortical plate.

STRATEGY FOR THE TREATMENT OF REGIONAL MALOCCLUSION

Cases of regional malocclusion have developed without disturbing the rest of the arch, and it is good strategy to correct them in the same manner.

A lingual arch is attached to the first or second molars, as may be preferred, to stabilize the anchor teeth. A segment of the labial arch is then used to move the

misplaced teeth into alinement. It is, as a rule, poor strategy to use a complete labial arch, in regional cases, subjecting normal teeth to unnecessary force and perhaps misplacement.

It has been customary in the past to concentrate one's effort on the tooth pushed out of alinement; whereas, it is better strategy to concentrate on the neighboring teeth that are responsible for crowding this tooth out of place. Even extraction has been resorted to in such cases, but, with modern appliances, the necessity for such procedure is obviated. As space is made by returning the neighboring teeth to their proper positions, the tooth out of alinement tends to assume its rightful place in the arch.

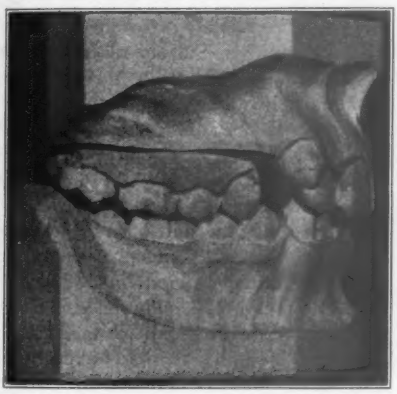

Fig. 22.—Cast of case showing that, almost of their own accord, the cuspid and lateral incisor will drop into place when misplaced buccal segment is moved posteriorly to proper position in relation to key ridge.

STRATEGY COMMON TO MASS AND REGIONAL MALOCCLUSION

One phase of orthodontic strategy is common to all malocclusion in which lateral expansion of one or both arch segments is needed.

Most cases require expansion in the molar and bicuspid regions, with rotating, righting and torquing of individual teeth; and with intrusion, extrusion and lateral movement of individual teeth, to bring them into arch alinement and under proper axial stress.

Labial arches, such as the open tube, the ribbon arch and the edgewise arch, rotate, make upright and torque teeth. Used also for expansion of the lateral segments, these complete labial arch wires require considerable bulk and strength, which is applied throughout the arch, affecting not only the lateral segments but also the anterior segment, which is the weakest part of the denture, where gentle force and extreme care are emphatically indicated.

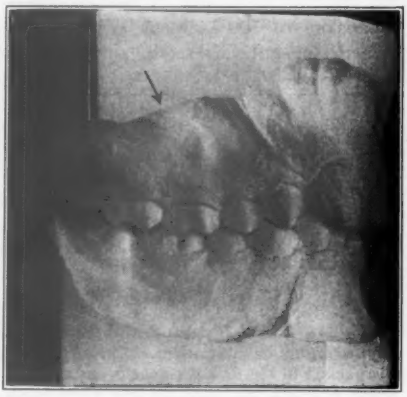

Fig. 23.—Orthodontic study cast made to show key ridge (indicated by arrow). The mesiobuccal root of the first molar projects into the canine fossa.

The lingual arch, on the other hand, is ideal for expansion in the molar region, where its attachment permits bodily movement instead of tipping of the anchor teeth. Expansion in the bicuspid and cuspid region must be gained by auxiliary springs attached to the lingual arch, which tip the teeth rather than move

them bodily. Rotation and root movements by this means are difficult.

It is logical to use the good qualities of both the labial and lingual types of appliances, eliminating or overcoming as far as possible the objectionable features of each.

The lingual arch, its tipping action nullified by use of a flat labial wire, is employed therefore to gain expansion in the molar region, where considerable force, relatively speaking, is needed. Thus, with no interference with the anterior teeth, room may be made for them. When lateral segments are contracted, the anterior teeth are misplaced; when expansion of the lateral segments is gained, the anterior teeth, aided by lip

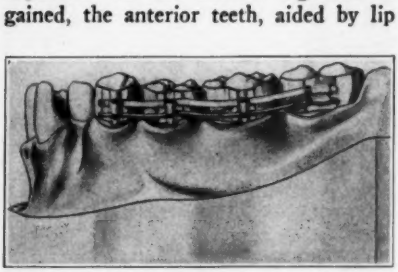

Fig. 24.—Buccal segment with buccal wires applied in universal brackets. The anchor lug is attached to the first permanent molar. Anterior brackets are used on the three teeth anterior to it. The round gingival wire is 0.012 or 0.015 inch, and the rectangular wire, 0.010 or 0.015 by 0.028 inch.

pressure, often tend to aline themselves. By the time there is sufficient lateral expansion, the anterior teeth will often have greatly improved their position without the aid of bands and appliances. When necessary, they can be banded for a brief period and treated after space has been prepared for them. Instead of being subjected over a long period to heavy force made erratic by the exigencies of other tooth movements that are being made by the single arch wire, the anterior teeth may be corrected in a short period by a gentle force intended exclusively for their own movement.

When the anteroposterior relations of the dentures are correct and lateral expansion of the arches is indicated, the molars are moved buccally in an upright or controlled position by means of the lingual arch. Force is applied to the other buccal teeth by means of auxiliary lingual wires; but these teeth are banded and a section of thin flat wire is applied in labial brackets from the anchor tooth as far forward as desired. By this means, the buccal teeth are moved without tipping. They may, at the same time, be rotated, moved bodily or torqued.

If, in addition, the buccal teeth lean either mesially or distally, they may be made upright by the use of a round wire in a separate horizontal slot in the gingival end of the labial bracket. The bracket used, known as the universal bracket, contains two transverse slots. There is a vertical slot, opening toward the incisal aspect in the manner first used by Victor Hugo Jackson, in 1886, and later by Edward H. Angle for his ribbon arch wire. The gingival slot opens buccally and is similar to that in the open tube or channel bracket used by Calvin S. Case, in 1910, and later by James D. McCoy in his open tube bracket and by Edward H. Angle for his edgewise arch wire.

All of these earlier types accomplished movements in all three directions with one arch wire. This necessitated complicated bends, which inadvertently often applied force in directions not desired. To attempt rotating, extruding, torquing and making upright mesiodistally, by intricate manipulation of a single heavy wire, made each tooth liable to movement by a force not intended for it, but applied inadvertently, and the presence of which was many times not even suspected by

the operator until the undesired movement had become evident.

It seemed good strategy, therefore, to divide this single wire into components each of which has a definite function to perform and performs it almost automatically.

The gingival round wire 0.010 or 0.012 in diameter is sprung into the horizontal slot without bending except to approximate arch form and occlusal curvature. It intrudes and extrudes teeth and makes their roots upright mesiodistally; and does this almost automatically and with uncanny ease and certainty.

Meanwhile, a flat wire, 0.010 by 0.028 inch, formed as was the gingival wire, is sprung into the incisal slots. The incisal wire may be used merely to stabilize the teeth, while the gingival wire induces movement in other directions, or this thin incisal wire will automatically rotate teeth and make their roots upright buccolingually. The wires act in unison to expand the arch.

Thus, it is seen that each wire is readily controlled and that the two may be used in unison, independently of each other; or either may be used singly. Either or both wires may be used as complete arch wires or in segments for any portion of the arch in which it is needed. Both wires are locked in the bracket by a single-lock pin.

One serious disadvantage of the simple labial arch wire was the fact that the anchor teeth were unduly disturbed while force was being applied to the buccal and anterior teeth. Now the lingual wire stabilizes the molar teeth so that they remain undisturbed, while the small resilient wires leading out from this anchorage accomplish various other tooth movements.

The buccal segments of constricted arches have usually drifted forward also. Expansion with the teeth in this the forward position would require breaking into or through the buccal cortical plate. Expansion of the lateral segments is most readily gained by moving the teeth buccodistally through the cancellous bone that lies between the cortical plates. Cancellous bone is the transitional form of bone, in which change takes place readily. It is always good strategy, therefore, to move teeth whenever possible in cancellous bone, rather than in or through the dense ivory-like bone of the cortical plates.

Formerly, the retruding pressure of intermaxillary elastics was applied to the entire denture or to the molars alone, by the expedient of turning the lock nut back against the buccal tubes of the molar bands. This carried the arch and all attached teeth forward. The elastics pulled them backward; and the next adjustment of the lock nuts again forced them forward, this undesirable oscillating of the anterior teeth continuing throughout the process of retruding the molars.

This movement of anterior teeth may be avoided by means of sliding intermaxillary extension hooks, which transmit intermaxillary force directly to the molars without disturbing other teeth. After the molars have reached their rightful positions in relation to the key ridge, the intermaxillary force is applied to other teeth as desired.

Should it be desirable to extend the arch forward, as in opening the space for one or both bicuspids, this is nicely accomplished by means of coiled springs. The distal end of the flat labial wire is bent back upon itself to extend forward a suitable distance from a buccal molar lug dimensioned to accommodate it. The forward end of the recurrent wire is bent into a hook. A coiled spring is slipped over the doubled wire before it is inserted into the molar lug, so that the spring is

compressed between the molar and the arch-wire hook.

NATURE OF THE APPLIED FORCE

There is a definite trend in modern orthodontic strategy toward the reduction, refining and control of the force used to move teeth. Pain is thus largely eliminated, the teeth move more rapidly, the bone changes induced are more nearly physiologic and there is less danger of root resorption or gum recession.

When a heavy wire is sprung into a close-fitting bracket, the tooth and its periodontium are subjected to a terrific initial force, which is repeated with each adjustment of the arch wire. Small resilient wires do not cause this initial jolt to the periodontium; the application of force is gentler and more continuous and not so quickly spent. The periods between treatments are greatly lengthened.

All of this is particularly true during the early period of treatment, when the teeth are badly crowded. During this initial period, two round wires of 0.010 or even 0.008 diameter are used in the universal bracket. No special bands are required to spring these wires into the brackets. Their pressure is exceedingly gentle and their accomplishment almost miraculous.

SUMMARY

Success in orthodontic practice depends not only upon the making and manipulating of appliances, but also on the operator's ability to develop an effective strategy for the treatment of each case.

Malocclusion falls naturally into two main divisions, each having its own distinct strategy of treatment. They are: (1) mass occlusion, affecting the entire denture and skull relationships, and (2) regional or localized malocclusion. Mass malocclusion is caused by conditions of heredity, the general physical condition or extraneous pressure affecting the entire denture. A first requisite of treatment is the detection and elimination of the extraneous pressures.

The key ridge of the superior maxillary bone is a distinct aid in the diagnosis of denture-skull relationships.

Cases of mass malocclusion in which the upper denture is anteriorly placed call for retrusion rather than expansion in the forward position. The lateral segments are retruded first, after which the anterior segment is corrected.

Regional malocclusion is caused by extraneous pressure, extra-oral or intra-oral conditions affecting localized areas. The etiologic factors must be eliminated.

Postural habits may be detected by means of a specialized candid camera.

Bone deformities which accompany malocclusion may be diagnosed from both the impressions and the study models.

Regional malocclusion calls for regional treatment. This is accomplished by stabilizing the anchor teeth with the lingual arch and moving other teeth by judicious use of arch segments or complete arches.

The labial arch wire is divided into two small resilient arches, locked in a single bracket having two slots and known as the universal bracket. Each arch performs a definite function.

By this strategy, the application of pressure is gentler and more nearly continuous; there is less discomfort; bone changes are more nearly physiologic; treatments are less frequent, and results are attained more rapidly.

First Trust Building.

PRACTICAL POINTS IN THE PULPLESS TOOTH PROBLEM*

By M. D. HUFF, A.B., D.D.S., F.A.C.D., Atlanta, Ga.

IT is the purpose of this paper to give encouragement to those who are unwilling to follow the line of least resistance and extract teeth for no better reason than that the pulp had been lost. More than twenty years ago, I was assigned the affirmative of a debate on "Resolved That All Abscessed Teeth Should Be Extracted," and won it. A month later, I was assigned the negative side of the same question and again won. When I was asked which side was correct, my answer was "Neither." There are three sides to every question: your side, my side and the right side.

The following discussion will present ideas and methods found practical after many years of testing.

The question of focal infection, which pointed the finger of suspicion at every pulpless tooth regardless of roentgenographic findings, is responsible for the wholesale condemnation of many harmless teeth. The voice of experience speaks in defense of these most important organs of mastication.

Have you ever been asked to extract teeth because a patient was losing weight and strength? After compliance with such request, has it been found that the patient had malaria? That happened to me. I was trying to assist a noted orthopedic surgeon to determine the relation of the pulpless tooth to arthritis and other systemic manifestations of infection. One of his patients, a woman, aged about 30, came in on crutches, suffering from an abscess in the hip. On roentgen-ray examination, three teeth were found which had been treated when she was about 12 years of age by some one who had used one of the patented nostrums supposedly for pulp mummification. On extraction of the three teeth thus treated, which were found to have extensive rarefied areas periapically, it was discovered that the same strain of bacteria were harbored by these teeth that were found in the hip when it was drained.

In the study made with this surgeon, the importance of a general examination became very evident, because, in some cases in which extractions were made, patients were not benefited, and when no extraction was made, the patients were cured by other treatment. Many times, the dentist should defend the teeth and suggest looking backward and downward for the real offenders.

In another case that has an important bearing on this question, a man, aged 50, was under treatment for iritis and was growing steadily worse. Roentgen-ray examination revealed a granuloma on the right upper cuspid, immediately under the eye affected. After extraction of the tooth, the patient was sent home by his physician without further treatment. He was entirely cured.

*Read before the Section on Operative Dentistry, Materia Medica and Therapeutics at the Seventy-Eighth Annual Session of the American Dental Association, San Francisco, Calif., July 16, 1936.

DIAGNOSIS

These case reports merely emphasize the importance of correct diagnosis, and let me say with all the emphasis at my command that the location in the arch should have nothing to do with the diagnosis because, if the method is not applicable to upper and lower second molars, we should employ one that is safe in considering these teeth, than which there are none more important. Later, one will be presented for consideration. The position in the arch, except possibly for third molars, and they are not always exceptions, should not enter into consideration.

The number of root canals should determine neither the value nor the fate of the tooth in question.

If the continuity of the lamina dura is broken and there is evidence of resorption of the apex of the root of the tooth, it is past the safety point.

If the patient is beyond 50 years of age and has systemic complications, conservative treatment is ill advised. A tooth which is affected by periodontoclasia to the extent of from one-third to one-half the length of the root is a bad risk, because of the liability of reinfection from that source. Teeth which have contributed to the formation of extensive cysts should not, as a rule, be retained. Those which have been abscessed and have drained into maxillary sinuses should be removed. All others which can be opened and filled to the end of the roots after proper sterilization should be retained unless serious systemic complications are already in evidence.

The foregoing observations refer, of course, to those teeth which are already pulpless and may or may not show signs of infection on roentgenographic examination. It goes without saying, therefore, that those teeth merely having exposed vital pulps should be saved. Those of you who advocate extraction of these teeth should be consistent and condemn all teeth having cavities or recession of the gums, because it has been proved that even these may, and often do, have bacteria present within their vital pulps.

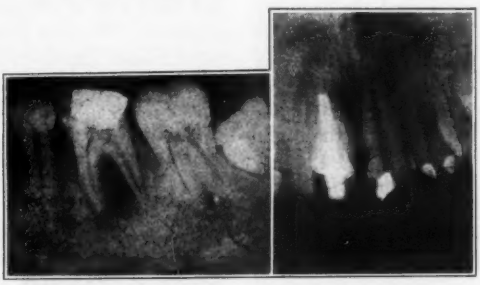

Fig. 1 (Case 1).—Effect of attempted mummification.

THE ATLANTA CLINIC CLUB

The conscientious dentist should feel very keenly his duty to his patient in the preservation of his teeth and his health. Realizing this, twenty-odd years ago, Harry B. Johnston, of Atlanta, Ga., organized the Atlanta Study Club. Out of this came the Clinic Club, to study the pulpless tooth problem with the hope of finding a satisfactory solution.

We studied the method of opening and enlarging canals by chemical and mechan-

ical means and developed a positive method of sterilization of the tooth and the adjacent tissue. We believe our experiments showed that it is better to remove all of the pulp and fill the canal thoroughly than to leave a part of the pulp and have it die later, inviting bacterial invasion. We also found that no permanent injury is done by the proper use of 40 per cent sulphuric acid to aid in cleansing the canals. We found that it is not easy to force it through a canal in the mouth or through the canal of an extracted tooth held in the hand.

Of course, no one advocates pumping any substance which coagulates albumin through the root end, but the point is

Fig. 2 (Case 2).—Lower first molar ionized and filled Oct. 27, 1925.

that it does not happen in the normal process of removing the débris and natural obstructions from a canal in order that it can be properly filled. This is the only method yet put forth which makes it possible to open and fill the canal and its multiple foramina.

A great many papers have been written condemning the use of any acids in canals, but we have slides showing results which cannot be successfully controverted.

It was Dr. Johnston who advocated the use of Churchill's tincture of iodine for ionizing a tooth, and the study club aided in the experiments which proved its dependability. It is the firm conviction that we can render a better service to the patient by adopting this procedure than by the sacrificing of teeth, that has brought me across the continent to give you this message.

I know that I have benefited more pa-

Fig. 3 (Case 2).—Lower second molar ionized and filled Nov. 29, 1932.

Fig. 4 (Case 2).—Case shown in Figures 2-3; May 30, 1936.

tients in this way than I have by extractions. Realizing the responsibility for this statement, as I do, and what it might mean to the public we serve, it takes implicit confidence in this method for me to make this statement. This confidence came after our experiments with ioniza-

tion with iodine were completed and practical cases checked after six months, one year, two years and now after more than fifteen years.

We took, for instance, every tooth extracted because of infection and showing a granuloma at its apex and if, on extraction, the granuloma came with the tooth, it was examined by an expert laboratory technician for aerobic and anaerobic bacteria. Then the tooth was ionized for thirty minutes with Churchill's iodine. The tooth was crushed and the granuloma was cut into sections and the tooth particles and the granuloma were put into all kinds of media and incubated for seventy-two hours. In all cases, the report was "no growth."

As you know, those who formerly advocated ionization, using salt solution or zinc chloride, took fifteen minutes, and, in many instances, showed excellent results. But we found that after fifteen minutes' ionization, it often happened that some of the bacteria were not killed and we found a few colonies growing within the seventy-two hours. So the time was doubled and, as reported above, there was no growth in any instance.

Not being satisfied with that experiment alone, we took cases *in situ* and treated them for thirty minutes and afterwards sealed the canal hermetically. After thirty days, the tooth was opened and fluid from the periapical area was found to continue to be sterile. This was repeated months later and, on being found sterile, the tooth was filled. In addition to this proof, we have literally hundreds of cases still *in situ* which show regeneration of bone where formerly there was evidence of granulomatous tissue.

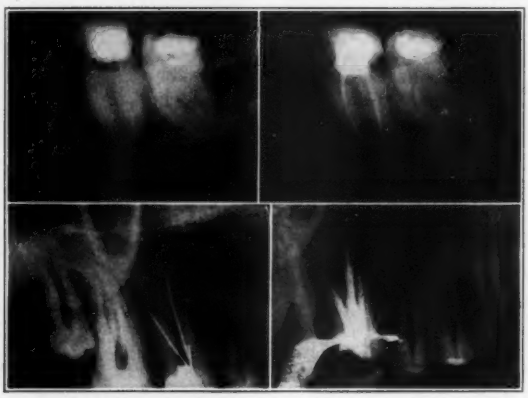

Fig. 5 (Case 3).—Ionizing and filling (work of students at Atlanta-Southern Dental College).

We do not advocate use of an excess of filling material, which forms comparatively large buttons in the crater usually present at the foramina of teeth, but we do believe that less harmful effects are produced by the use of this sterile and inert material than by bacterial invasion when a root canal is only partly filled.

New bone fills in closely about this material, and if and when one of these fillings is removed and examined, it will be found that a small amount of cicatricial tissue surrounds the little button. I

have heard it said that such tissue is nine times as hard to reinfect as normal tissue.

TREATMENT

There may come a time when our children's children will take proper care of their teeth and no child will have exposed pulps and pulpless teeth as a result of neglect, but, until then, we are confronted with the problem of maintaining proper mastication in these growing children, to whom this function is just as important as it is to any adult. My position, in this instance, is that the tooth itself is the best space maintainer available and we must make its retention safe for the child.

The teeth of these young children take very kindly to conservative treatment, and a small crystal of thymol melted over a freshly exposed area, and followed by soft copper cement, may save such a pulp. If this treatment is not deemed advisable, pressure anesthesia is used, with subsequent filling by placing a paste of compound of oxide of zinc and eugenol and about 5 per cent iodoform, which is carried into pulp chamber and canals, dried, condensed by sterile cotton pellets and covered with cement or metal filling. The pellets are used merely for condensing the material and not as part of the filling.

A deciduous tooth which has become putrescent may be saved if too much tis-

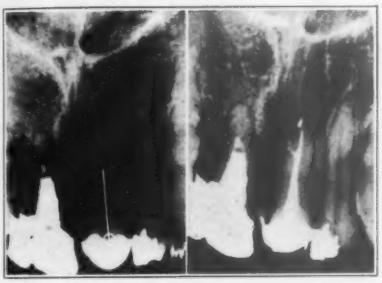

Fig. 6 (Case 4).—Filling of lateral canal in upper central incisor.

Fig. 7 (Case 5).—Film taken Nov. 23, 1934.

Fig. 8 (Case 5).—Case shown in Figure 7; tooth ionized and filled Dec. 3, 1934.

Fig. 9 (Case 5).—Film taken June, 1936. There is definite regeneration of bone.

sue has not become involved adjacent to the incoming permanent tooth. It should be drained until the acute stage is passed if an acute abscess has developed, and then sulphuric acid neutralized by sodium bicarbonate may be used to remove decomposed and infectious material from pulp chamber and roots. After sufficient treatment to insure sterility, the same paste as above described should be used. No gutta-percha points should be used in filling the roots of deciduous teeth, for obvious reasons.

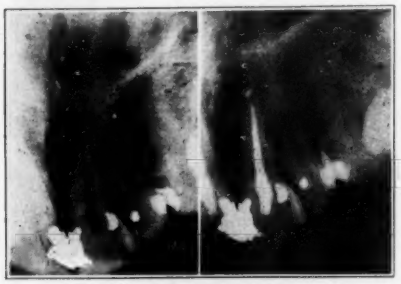

Fig. 10 (Case 6).—Before and after ionization. Regeneration of bone is evident.

Fig. 11 (Case 7).—One canal half filled and one well filled.

PERMANENT TEETH WITH VITAL EXPOSED PULPS

These cases call for careful consideration, and the treatment must be selected judiciously. The accidental exposure of a formerly healthy pulp does not always mean that a canal operation is indicated. In many instances, vitality may be preserved for many years. The fused thymol crystal followed by soft cement often serves this purpose. All capped pulps, no matter what method is used, should be checked for vitality at regular intervals.

Fig. 12 (Case 8).—Case in which, although conditions were considered unfavorable, ionization was done April 12, 1924.

Fig. 13 (Case 8).—Film taken June 3, 1936.

Extirpation is advisable in most cases when irritation and infection have resulted from caries. Block anesthesia has made this operation much safer. The old-fashioned pressure method fre-

quently defeated the purpose of the operation by forcing bacteria into the periapical space. Now one can and should remove all caries and disinfect the cavity by means of a cresatin solution or hexylresorcinol after anesthesia has been accomplished. In this operation, it is best to remove all of the pulp to the apex and, of course, in a surgically clean manner. The root filling may be placed at this sitting, but I prefer to hermetically seal sterile cotton points in canals for three

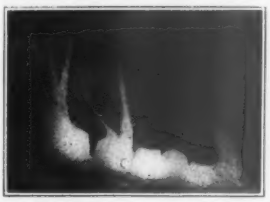

Fig. 14 (Case 9).—Bicuspid and molars ionized and filled in 1922. Extraction, in a man, aged 24, had been advised on account of ill health. His health was regained without loss of a tooth.

Fig. 15 (Case 9).—Case shown in Figure 14; in 1924.

or four days. Any portion of pulp tissue remaining in the roots may be removed at this time. In most of the ten anterior teeth, this can be done without chemical aid. In multirooted teeth, it is far better to use the acid and sodium bicarbonate method to enlarge canals and to remove all of the pulp. No effort is made to go through the apex in these cases. Nevertheless, the roots should be filled to the end. This does two things: (1) it places a sterile filling material where there would be decomposed and infected organic material later and (2) it affords roentgenographic evidence that the work is well done and cannot be interpreted as an imperfect operation by someone who follows the operator in looking for probable sources of systemic infection.

PERMANENT TEETH HAVING NON-VITAL PULPS

Permanent teeth having non-vital pulps call for additional measures. First, the Callahan method of opening and enlarging the canals is definitely indicated.

Fig. 16 (Case 9).—Case shown in Figures 14-15; June 8, 1936. The patient was still in good health.

In all of these cases which have been diagnosed as favorable, the main canals and all lateral canals, as well as all foramina, must be freed from all infected and disintegrated material. No mechanical reamers or files can possibly do this, and acid and sodium bicarbonate will. All of these cases require ionization.

For satisfactory ionization, it is necessary to have the apices open. If iodine is used, it is advisable to adjust 30-gage platinum wire in each canal and connect these wires to the negative pole of the

ionizing machine. Not more than 0.5 milliampere per canal should be used because the use of more than that amount will cause coagulation of the periapical tissue. The positive pole is placed in contact with the inner surface of the cheek on the side on which the tooth is located. As before mentioned, thirty minutes will be required to thoroughly sterilize the tooth and the periapical tissue. This is done after the rubber dam is applied and, in this instance, the canal filling should be placed immediately and under surgically clean conditions.

FILLING

The perfect canal filling material has not been produced up to the present time. The illustrations and case histories presented tend to show that we have a practical and workable method.

After the ionization has been finished, the excess iodine is absorbed by introducing sterile cotton points in the canals and pulp chamber, then flooding with grain alcohol, not less than 85 per cent strength. The excess of alcohol is removed in the same manner, then the canal is filled with chloresin solution, which will be diffused in the alcohol. Then a gutta-percha point, which is slightly smaller and considerably longer than the canal, is introduced and gradually carried to the end of the canal. A gentle stirring motion, not pumping, is used until this point is dissolved. Another point is then introduced, and then others are introduced, until a dense filling has been secured.

Further details of this method may be had by reference to papers presented by Harry B. Johnston, to whom credit is due for perfecting the technic.

APICOECTOMY

Apicoectomy can be used occasionally with success. Indications are that it is being used less frequently than it was several years ago, probably owing to the percentage of failures.

CONCLUSIONS

1. Diagnosis plays an important part in the pulpless tooth problem, as in all pathologic conditions.

2. The age and state of health of the patient are important factors in diagnosis. The location and number of roots should not enter into consideration except in a few instances.

3. When infection is present in root canals and periapical tissue, ionization can be depended on for sterilization.

4. Churchill's tincture of iodine has proved very efficient in this connection.

5. The combination of chloresin and gutta-percha in filling the roots of teeth is recommended because, with these materials, not only the main canals are filled, but all lateral and transverse canals and multiple foramina as well.

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A FURTHER REPORT ON PHYSICAL PROPERTIES AND CLINICAL VALUES OF PLATINUM-CENTERED GOLD FOIL AS COMPARED TO PURE GOLD FILLING MATERIALS*

By R. W. RULE, D.D.S., San Francisco, Calif.

AT the time that the preliminary report[1] on this subject was made, in April 1934, it was realized that there was much still to be done. In order to make the investigation of greater value, it would be necessary to devise a practical means of preparing a much larger number of specimens and perhaps to include other materials and other tests; in fact, to extend the investigation to a larger field.

It was found essential to investigate foils made with varying percentages of platinum, and as inquiries were coming in as to a new product on the market (listed in Table 1 under the manufacturer's letter O), it was decided to include at least one or two makes of mat or crystal gold as well as pure gold foil from a number of different manufacturers.

A new start was made. Instead of attempting to prepare many cavities in extracted natural teeth, a split steel die was made having four cavities, each 10 mm. in length, 1.5 mm. in width and 1.5 mm. in depth. The ends were made to diverge slightly from the base of the cavity outward so that after separation of the die, the specimens might be forced out of the die without too great difficulty.

These dimensions were chosen as being about the minimum that would permit all of the tests to be made satisfactorily, and yet not so great as to be too difficult to fill or requiring an unreasonable amount of material. This die could be used for as many series of specimens as desired.

All told, forty-three specimens were made. Twenty-three were of pure gold, and twenty were of gold and platinum. Five specimens were made of one form of crystal gold and four of an electrolytically precipitated mat gold. The other fourteen specimens of pure gold were of No. 4 soft gold foil, the products of four manufacturers.

The gold and platinum specimens included materials from three sources with platinum in the proportions of 10, 15, 30 and 40 per cent. One firm supplied materials of 10 and 15 per cent platinum, another firm 15, and still another, 30 and 40.

One specimen, made of non-cohesive pure gold, would be of value only for comparative hardness and density, and, of course, the average of a number of specimens would be needed for the results to be of much value.

Brinell hardness tests were made on all specimens. These tests were made using a 10 kg. weight on a one-sixteenth inch ball for thirty seconds and calculating the hardness numbers according to the standard formula.

In the density tests, which were made on all but four of the specimens, comparison of the weight in air and in

*Contribution from the Division of Physical Sciences, College of Dentistry, University of California.

methylene iodide was made, the results being considered more accurate than could be had by comparing the weight in air and water with such small specimens.

It is estimated that the figures are accurate to ± 0.2 in the density tests, and ± 0.5 in the hardness tests, with a uniformity in the specimens up to ± 2.0.

Tensile strength tests were made on eleven pure gold specimens and on thirteen gold and platinum specimens. At first, an attempt was made to test the tensile strength without special preparation of the specimens, but it was found that the ends would flatten in the jaws of the machine and thus be released before the specimen would break under tension. The specimens were then placed in the lathe and turned down to cylindrical form in the center portion, the ends remaining square where they were to be gripped by the machine. This proved effective. The difficulties encountered in the preparation of the specimens, coupled with the character of the break or cleavage and the degree of elongation under the test, brought out some interesting and valuable points, which will be discussed later.

For the present, let us say only that twenty-four specimens were successfully prepared and tested, thirteen were spoiled in the preparation and six were impossible of preparation, the one specimen of noncohesive gold and five of crystal gold, which, by the very nature of the directions supplied with this particular material, could not show any measurable strength of cohesion because of contamination of the gold by the liquid used on the condensers.

The specimens of this report, as compared with those of the preliminary report, are higher in the hardness and density figures because they were made in the steel die, whereas the earlier ones were made in cavities in extracted teeth. The figures are closely comparable to those of the earlier specimens after they had been put through the rolling machine and condensed to maximum hardness and density.

The human element in such work as this is a thing impossible to control. Conditions under which the work was carried on were not always entirely favorable. The same assistant was not always available for malleting, nor was the work of either operator or assistant at all times just the same.

The necessity of undertaking the work at such intervals and for such short periods as were available was another handicap, as was also the lack of suitable apparatus for some of the tests. Undoubtedly, these things would account for a measure of variation in the results, which would not have occurred without such lack of control. On the other hand, every effort was made to keep the working conditions as nearly constant and accurate as possible, and it is felt that fairly definite conclusions can be drawn from the results.

So far, tests have been made of Brinell hardness, density, tensile strength and elongation. Flow and shearing tests have not yet been made.

Table 1 gives a general statement regarding the data and conditions of all the tests. Omission of figures indicates that, for some reason, the test under consideration was not undertaken or was not completed with that particular specimen. In order to analyze and make deductions from these data, it has been necessary to arrange them in many different groupings and consider all the factors involved, making allowance too for the personal equation.

Figure 1 shows a graph of the pure gold specimens arranged in the order of Brinell hardness, which is shown by a gradually descending curve beginning at

73 and ending at 23. The density is shown by the second curve, ranging from a high of 19.5 to a low of 17.6. Tensile strength and elongation are represented by the two lower curves. The figures for the tensile strength are astonishingly high for malleted pure gold fillings, which must depend on homogeneity produced by thorough cohesion. These figures were checked and rechecked and more specimens made and the tests duplicated, so that they are undoubtedly accurate to within 3,000 or 4,000 pounds per square inch. It is believed that they are the first figures published on the tensile strength of filling materials depending on cohesion for their strength.

Figure 2 shows a similar graph of the gold and platinum specimens arranged in the same way, while Figure 3 shows Figure 2 superimposed on Figure 1.

Table 2 is a table of averages. It gives the average Brinell hardness, density, tensile strength and elongation of the specimens arranged in groups according to the materials and the average tensile strength of the pure gold, and the gold and platinum arranged in groups according to the type of condensation, whether by hand mallet or mechanical mallet.

TABLE 1

The specimens were made in series of four, and each series given a letter, as A-1, A-2, A-3, A-4. In Table 1, the specimens are not given in the order in which they were made, but the pure gold and the platinum centered gold are segregated, and each group is given in the order of the Brinell hardness.

The manufacturers of the materials are listed under the letters M, N, O, P, Q, R, and those concerned will be supplied with copies of this report. It is hoped that their materials will be improved as a result, at least as far as the platinum centered gold is involved.

Crystal Golds.—The particular crystal gold used in this investigation, when thoroughly malleted, seems to make as hard a filling as any of the pure golds, though slightly below average in density. It has no advantage as regards the time required to make the filling. When it is used with hand pressure, as is usually advocated, the time may be shortened, but the density is lessened, and the hardness greatly reduced, much the poorest showing of all of the materials tested resulting.

This gold is one with which employment of a liquid material supplied by the manufacturer is advocated. The use of this liquid is entirely superfluous and utterly opposed to all the principles of the proper handling of gold filling materials. Moreover, when the specimen is removed from the steel die, it may be easily broken up between the fingers. The Brinell hardness of the hand pressure specimens is less than half that of the average of all pure gold malleted specimens, and only two-thirds that of other hand pressure specimens. The density was the lowest of all. The use of the liquid did not affect the density or hardness, but certainly affected the cohesion. No other crystal golds were tested, though of course other makes would need to be tested in order to make a comparison of crystal golds in general with other forms of gold filling material. It is doubtful that this is worth the effort, since clinical experience seems to point to the use of foils. The one malleted specimen showed hardness, but appeared to be brittle and lacking in strength. An attempt was made to prepare it for a tensile strength test, but its brittleness caused it to break up in the lathe.

Mat Golds.—An electrolytically precipitated mat gold was included in the investigation. Two malleted specimens showed average hardness and were only

TABLE 1.—DATA ON VARIOUS MATERIALS

Specimen	Manufacturer	Material	Brinell Hardness	Density	Tensile Strength Lbs. Per Sq. In.	Elongation Per Cent	Time Minutes	Condenser	Type of Condensation	Remarks
C-1	O	Crystal gold	73	18.9	.....	....	32	Manufacturer's special	Hand mallet	No liquid used, large pieces thoroughly malleted all way through
C-4	P	Pure gold No. 4 soft	68	19.5	35,000	11	35	9x4-3-3	Hand mallet	Slightly irregular break under tensile strength test
C-3	O	Pure gold No. 4 soft	64	19.5	.....	....	24	9x4-3-3	Hand mallet	Specimen broken in preparation for tensile strength test
C-2	O	Pure gold No. 4 soft	63	19.5	37,500	15	34	9x4-3-3	Hand mallet	Clean necking break under tensile strength test
K-2	R	Pure gold No. 4 soft	60	19.4	.....	....	..	9x4-3-3	Hand mallet	Specimen broken in preparation for tensile strength test
K-3	(Mixed)	Pure gold No. 4 soft	60	19.4	38,700	20	..	9x4-3-3	Hand mallet	Clean necking break
E-2	N	Mat gold	57	19.3	.....	....	30	Manufacturer's special	Hand mallet	Specimen broken in preparation for tensile strength test
E-3	N	Mat gold	54	18.5	35,000	10	22	9x4-3-3	Hand mallet	Clean break (usual method of condensing this kind of gold by hand pressure)
E-4	N	Mat gold	52	19.0	.....	....	45	Manufacturer's special	Hand pressure	Specimen broken in preparation for tensile strength test
H-4	P	Pure gold No. 4 soft	52	19.1	31,780	12	8	5x20	Mechanical mallet	Two clean breaks under tensile strength test
H-3	P	Pure gold No. 4 soft	51	19.0	.....	....	..	9x4-3-3	Hand mallet	Specimen broken in lathe
J-2	Q	Pure gold No. 4 soft	51	18.9	30,800	6⅔	9	5x20	Mechanical mallet	Clean break (specimen made rapidly with large condenser and mechanical mallet)
H-1	O	Pure gold No. 4 soft	49	19.5	37,000	14	..	9x4-3-3	Mechanical mallet	Clean necking break
H-2	O	Pure gold No. 4 soft	47	19.1	40,000	20	..	9x4-3-3	Mechanical mallet	Clean necking break
J-3	Q	Pure gold No. 4 soft	47	18.8	36,400	12.5	22	9x4-3-3	Hand mallet	Slightly irregular break
J-1	Q	Pure gold No. 4 soft	43	19.4	51,500	....	12	9x4-3-3	Mechanical mallet	Clean necking break

Specimen	Manufacturer	Material	Brinell Hardness	Density	Tensile Strength Lbs. Per Sq. In.	Elongation Per Cent	Time Minutes	Condenser	Type of Condensation	Remarks
J-1	Q	Pure gold No. 4 soft	43	19.4	51,500	....	12	9x4-3-3	Mechanical mallet	Clean necking break
J-4	Q	Pure gold No. 4 soft	38	18.0	24,000	7	16	5x20	Hand mallet	Clean break
G-1	(Mixed)	Pure gold unannealed	36	18.0	.....	....	..	Foot condenser	Hand mallet	Unannealed soft foil, no tests possible except Brinell hardness and density
E-1	N	Mat gold	35	18.1	.....	....	45	Manufacturer's special	Hand pressure	
B-1	O	Crystal gold	28	18.2	.....	....	35	Manufacturer's special	Hand pressure	Used small pieces and some liquid, finished with malleting and burnishing.
B-4	O	Crystal gold	26	17.8	.....	....	13	Manufacturer's special	Hand pressure	Large pieces, no liquid, worked fast to match time suggested in directions
B-2	O	Crystal gold	24	18.1	.....	....	20	Manufacturer's special	Hand pressure	Large pieces, no liquid, finished with malleting and burnishing
B-3	O	Crystal gold	23	17.6	.....	....	20	Manufacturer's special	Hand pressure	Large pieces, used liquid, finished with malleting and burnishing
A-4	R	Gold & Platinum 40%	110	19.9	50,200	4.5	28	9x4-3-3	Hand mallet	Zigzag break, platinum showing in break
L-2	R	Gold & Platinum 30%	106	....	54,000	2	32	9x4-3-3	Hand mallet	Specimen broken in lathe
K-1	R	Gold & Platinum 40%	103	19.7	.....	....	..	9x4-3-3	Hand mallet	Specimen split in preparation through faulty cohesion
F-1	R	Gold & Platinum 40%	96	19.9	47,000	....	..	9x4-3-3	Mechanical mallet	Zigzag break, cohesion probably weakened by gold burning off platinum in annealing
A-3	R	Gold & Platinum 40%	92	19.4	.....	....	43	9x4-3-3	Hand mallet	Specimen spoiled in lathe preparation
L-1	R	Gold & Platinum 30%	92	....	40,800	4	30	9x4-3-3	Hand mallet	Clean break
D-4	R	Gold & Platinum 40%	89	19.9	.....	....	23	9x4-3-3	Hand mallet	Specimen brittle, spoiled in lathe preparation
F-2	R	Gold & Platinum 40%	89	20.0	59,183	4.5	..	9x4-3-3	Mechanical mallet	Zigzag break, cohesion apparently at fault

(Continued on next page)

TABLE 1.—DATA ON VARIOUS MATERIALS (Continued)

Specimen	Manufacturer	Material	Brinell Hardness	Density	Tensile Strength Lbs. Per Sq. In.	Elongation Per Cent	Time Minutes	Condenser	Type of Condensation	Remarks
F-3	R	Gold & Platinum 40%	88	19.9	50,000	4.5	..	9x4-3-3	Mechanical mallet	Zigzag break, cohesion apparently at fault
A-2	M	Gold & Platinum 15%	87	19.5	.....	....	38	9x4-3-3	Hand mallet	
D-1	M	Gold & Platinum 10%	87	19.5	44,750	7	30	9x4-3-3	Hand mallet	Clean break
A-1	M	Gold & Platinum 15%	84	19.4	35,555	4	50	9x4-3-3	Hand mallet	Clean break
D-3	M	Gold & Platinum 15%	84	19.4	40,000	4	28	9x4-3-3	Hand mallet	Clean break
D-2	M	Gold & Platinum 10%	84	19.5	53,077	7.7	30	9x4-3-3	Hand mallet	Clean break, slightly irregular
L-3	O	Gold & Platinum 15%	80	....	.....	....	21	9x4-3-3	Hand mallet	Broken in lathe, platinum showing in break
F-4	M	Gold & Platinum 15%	74	19.7	52,600	7	..	9x4-3-3	Hand mallet	Clean break
G-4	M	Gold & Platinum 15%	74	19.8	45,500	....	..	9x4-3-3	Mechanical mallet	Clean brittle break
L-4	O	Gold & Platinum 15%	73	....	45,000	8	23	9x4-3-3	Mechanical mallet	Clean break
G-2	M	Gold & Platinum 15%	70	19.1	.....	....	..	9x4-3-3	Mechanical mallet	Specimen split badly in lathe, cohesion apparently at fault
G-3	M	Gold & Platinum 15%	62	19.5	.....	....	..	9x4-3-3	Mechanical mallet	Cohesion apparently at fault

slightly below average in density. A greater number of specimens might have shown average density. The tensile strength was about average and elongation slightly below average. The manufacturer advocates hand pressure for this gold. When it was used in this way, the average Brinell hardness and density dropped low unless much time and force (too much for practical use) were used in the condensing, though they still remained higher than the crystal gold.

between the pure No. 4 soft gold foils produced by different manufacturers. Four specimens made from gold of manufacturer Q averaged lower in all of these qualities, yet one of the four specimens was above average in density and the highest of all the pure gold specimens in tensile strength. This is perhaps explainable by the fact that the mechanical mallet was used in this specimen, a further discussion of which will be given shortly.

There is a difference in the working

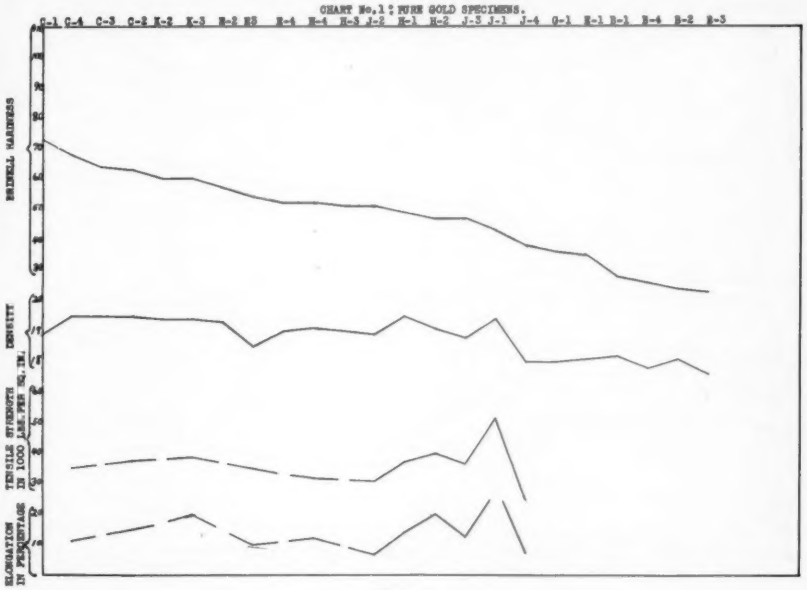
CHART No. 1 ; PURE GOLD SPECIMENS.
Q-1 Q-4 C-3 C-2 K-2 K-3 R-2 R3 R-4 R-1 R-3 J-2 R-1 R-2 J-3 J-1 J-4 Q-1 R-1 R-1 R-4 R-2 R-3
BRINELL HARDNESS
DENSITY
TENSILE STRENGTH IN 1000 LBS. PER SQ. IN.
ELONGATION IN PERCENTAGE

Fig. 1.

All tests would indicate that this gold has no advantage over No. 4 soft gold foil in hardness, density or tensile strength and that it has the disadvantage of being more difficult to handle and consuming more time for an equally good filling.

Pure Gold Foils.—It cannot be said that there is any special difference in hardness, density, tensile strength, etc., qualities of different gold foil materials, and the individual operator must determine this on the basis of his experience. Perhaps the nearest we can come to measuring this difference is by the tests of a class of students in their first technical work with gold foil in the laboratory. This was tried several years ago, and it is significant that a class doing a given quantity of technical work with a

certain make of gold foil completed the work with a considerably smaller quantity of gold than another class doing the same work with another make of gold; the difference evidently being in the amount of gold wasted. Experienced operators would not show this difference in waste, though they might readily recognize a difference in the working qualities. I have used three makes of gold foil which work so much alike that I question the ability of any one to distinguish them from each other by the working qualities alone. There are others which are slightly different in their working qualities, though not necessarily inferior.

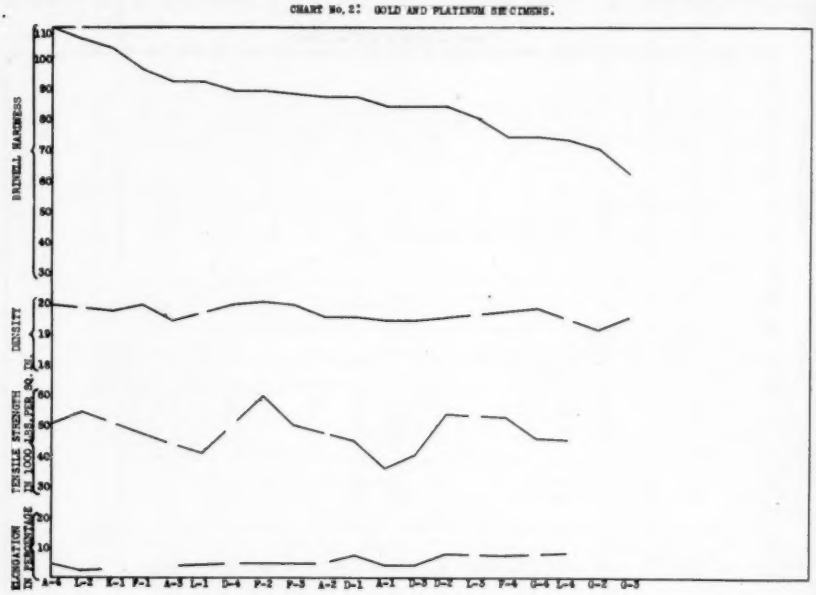

Fig. 2.

Condensation.—As regards the type of condensation, three methods were used: (1) hand pressure in most of the specimens of crystal and mat gold, with the instruments advocated by the manufacturer; (2) hand pressure combined with the hand mallet used by an assistant; (3) the use of the mechanical mallet with the electric engine. No specimens were made with the automatic mallet. Rather heavy burnishing was used alike on all specimens after completion of the condensation.

Hand pressure alone required a longer time for good work and produced a much softer filling and of slightly lower density. The combination of hand pressure and hand mallet gave the greatest hardness and about the same density as the mechanical mallet, but the latter gave the greatest tensile strength.

It is significant that of the specimens made with hand malleting, 47 per cent failed in the lathe preparation for the tensile strength test; whereas, only 15 per cent of those made with the mechanical mallet failed, and this 15 per cent was from the gold and platinum speci-

mens. This seemingly indicates that a slightly stronger specimen is made by the use of the mechanical mallet. This is no doubt due to the rapidity, and thus the shingling or overlapping of the blows, and to the increased aggregate number of blows. Too much importance should not be attached to this point since those specimens which were broken in the lathe gave way under the force of the cutting tool when the specimens were almost

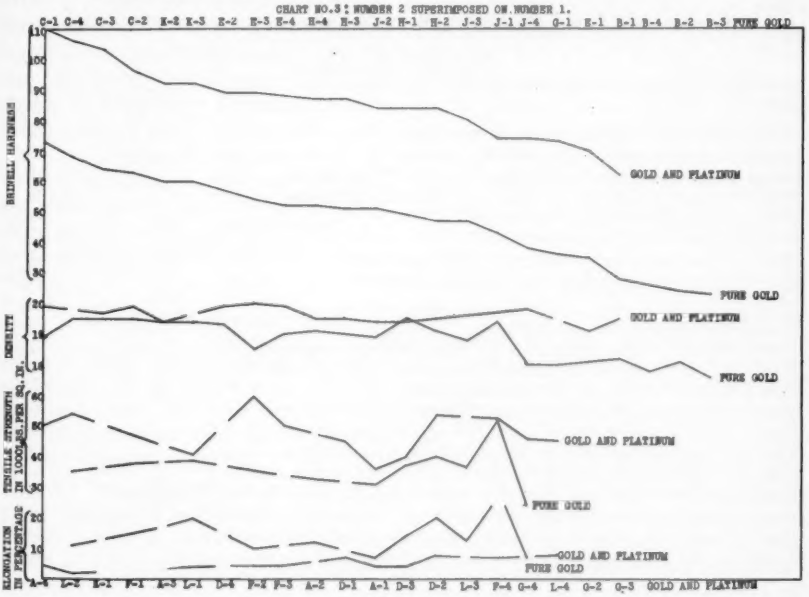

Fig. 3.

ready; which indicates that if the cutting could have been stopped just before the break, the specimens would no doubt have given a satisfactory tensile strength result, it being only slightly lower than that of the others.

An effort was made to determine the effect of the size of the condenser. Most of the specimens were made with a 9 by 4-3-3 parallelogram, the nib having a flat face area of 0.36 square millimeter, or with a straight 5 by 20 parallelogram, the nib having a flat face area of 1.0 square millimeter. As might be expected, use of the smaller point produced the hardest filling, the greatest density and the highest tensile strength. The differential in this was greater with the hand mallet than with the mechanical mallet.

Cohesion.—The handling of these specimens and an analysis of the data in Table 1 show that there was no lack of cohesion in any of the pure gold specimens except the crystal gold (for obvious reasons) and the unannealed specimen.

On the other hand, while cohesion in the gold and platinum specimens was sufficient for practical purposes, the area of cleavage in most instances seemed to give evidence that, at some points, the union between the gold and platinum was relatively weak. This is probably not due to any weakness in the union of

the gold and platinum as supplied by the manufacturer, but to the extreme thinness of the gold covering the platinum, permitting the gold at times to burn off in the annealing and so to introduce into the filling an area of uncovered platinum, a weak spot in the filling resulting. A possible remedy for this is offered under "suggestions to manufacturers."

COMPARISON OF PURE GOLD WITH GOLD AND PLATINUM AS TO BRINELL HARDNESS

A reference to Table 2 shows the average hardness of pure gold specimens to be 54. In the preliminary report, a reference was made to Hartman's data,[2] his two highest readings being 75 and 77, and to the fact that these figures are higher than other test results recorded in the literature. Since then, I have had an opportunity to talk with Hartman and to see his specimens, and I find that he has given the highest and lowest readings for each specimen; whereas, the average of the readings for each specimen would have been much lower than the figures that I have quoted. In this and the preliminary report, all figures given are the averages of from four to seven readings on each specimen.

Table 1 shows that five of the specimens run from 38 to 49, eight run from 51 to 60 and four from 63 to 73. Of the 10 and 15 per cent platinum content specimens, one reads 62 and ten range from 70 to 87; while nine specimens of 30 and 40 per cent platinum range from 88 to 110. Thus, we see that the average of low platinum content specimens runs 24 points above the average of the pure gold and the average of the high platinum runs 42 points above the pure gold.

TABLE 2.—AVERAGES

	Average
Brinell hardness of pure gold malleted specimens	54
Brinell hardness of gold and platinum specimens	86
Brinell hardness of gold and platinum 10% and 15% specimens	78
Brinell hardness of gold and platinum 30% and 40% specimens	96
Density of pure gold malleted specimens	19.1
Density of gold and platinum specimens	19.6
Density of gold and platinum 10% and 15% specimens	19.5
Density of gold and platinum 30% and 40% specimens	19.8
	Pounds
Tensile strength of pure gold specimens	36,000
Tensile strength of pure gold specimens made with large condenser	28,800
Tensile strength of pure gold specimens made with 9x4-3-3 condenser	38,500
Tensile strength of gold and platinum specimens	47,500
Tensile strength of gold and platinum 10% and 15% specimens	45,000
Tensile strength of gold and platinum 30% and 40% specimens	50,000
Tensile strength of pure gold specimens made with hand mallet	34,000
Tensile strength of pure gold specimens made with mechanical mallet	38,000
Tensile strength of pure gold specimens made with hand mallet and small condenser	37,000
Tensile strength of pure gold specimens made with mechanical mallet and small condenser	41,000
Tensile strength of gold and platinum specimens made with hand mallet	46,000
Tensile strength of gold and platinum specimens made with mechanical mallet	49,000
	Per Cent
Elongation of pure gold specimens	12.8
Elongation of gold and platinum specimens	5.0
Elongation of gold and platinum 10% and 15% specimens	5.5
Elongation of gold and platinum 30% and 40% specimens	3.9

This shows conclusively that any platinum content increases the hardness and that, in general, the higher the platinum content, the greater the hardness.

WORKING QUALITIES

The high platinum content foil did not seem any more difficult to handle than the 10 and 15 per cent, except that the definitely harder filling was more resistant to the cutting in the trimming and finishing process. How much the working qualities of these foils depends on the manufacturer's processes, I am unable to say. One lot of approximately No. 6 foil seemed to present the advantage of the gold being less likely to burn off in the annealing. Adequate comparision of the working qualities of foils of different platinum content could be made only after working with materials of different percentages supplied by the same manufacturer.

DENSITY COMPARISONS

G. V. Black[3] gives 19.42 as the highest density that he obtained by malleting pure gold into a steel die matrix. My figures range from 18.0 to 19.5, with four specimens running 19.5, three 19.4, and only two specimens below 18.8, the average being 19.1. These figures seem to agree well enough to show reasonable accuracy. The variations in density seem to be due largely to the size of the condenser and to the kind of gold. Leaving out the mat and crystal gold specimens, the average density of those made with a 9 by 4-3-3 condenser is 19.31. The large condenser does not affect the density so much when used with the mechanical mallet, the comparison being 19.0 to 18.0, but, as we have seen, the hardness is reduced.

The density of the platinum content specimens runs very evenly, the average for the high content being 19.8 and that of the 10 and 15 per cent being 19.5 as compared to 19.1 for the pure gold. This difference is proportionate to the platinum content and to the difference in the specific gravity of gold and platinum.

TENSILE STRENGTH COMPARISON

A comparison of the tensile strength with the size of the condenser used shows quite definitely that the large point markedly reduces the tensile strength. This comparison applies only to the pure gold specimens, since no gold and platinum specimens were made with the large condenser.

The average figures are 38,500 pounds per square inch as compared to 28,800 pounds per square inch. This fact should be noted by those who advocate using a large condenser to make the work faster and easier. This is evidently not a permissible shortcut to a good foil filling.

The next point we note is that with specimens of pure gold and gold and platinum all made with a small condenser, the figures for pure gold are 38,500 as compared to 47,500 for gold and platinum, or 45,000 for 10 and 15 per cent platinum and 50,000 for 30 and 40 per cent platinum. The increase in tensile strength is about proportionate to the quantity of platinum contained.

This increased tensile strength is of much practical importance in the step portion of Class 2 and incisal portion of Class 4 restorations if we can be sure of proper cohesion. Weak cohesion at just the wrong spot would prove disastrous. We must consider what has been mentioned and what the column under "remarks" in Table 1 emphasizes; i.e., that the character of break under tension *seems* to show that the cohesion is not so strong as the inherent strength of the metal. True, the figures show that in carefully made laboratory tests, the strength of cohesion is considerably greater than the tensile strength of pure gold, but the indication is that in work at

the chair, any carelessness on the part of operator or assistant might result in bringing the tensile strength much below the tensile strength of the pure gold and result in failure at a crucial point. A probable remedy for this is being suggested and, in the meantime, until it has been tried and proved, we may use the present gold and platinum foils with confidence, if due care and skill are exercised.

ELONGATION

It was difficult to measure the elongation of these specimens under breaking tension. The figures given are only approximate, but they show much less stretch or elongation in the gold containing platinum than in the pure gold. Here again, the difference is proportionate to the quantity of platinum contained. The figures are 12.8 per cent for the pure gold, 5.5 per cent for the low platinum content and 3.9 per cent for the high platinum content gold.

The combined effect of greater tensile strength and lesser elongation will be a distinct advantage in this material. It is well known that malleted pure gold fillings will flow and also stretch and break under stress too great for the strength and hardness of the material. When it seems indicated, we shall now be able to use the gold and platinum foil in those places where stress is heavy or where a large bulk of material is impracticable, with a fair measure of assurance that it will stand the strain and render satisfactory service. We shall also be justified in cutting the step portion of cavities narrower when this seems desirable.

TIME REQUIRED FOR CONDENSING

The time figures kept for the condensing of the gold are of comparatively little significance, especially as between the pure gold and gold and platinum foil, when the same instrument and method were used. If all materials and methods used are included, the method of hand pressure alone adds about 50 per cent to the time required and affords a less satisfactory result.

Large condensers greatly reduce the time, but at an unjustifiable expense of hardness, strength and density. The use of the mechanical mallet also reduces the time and increases the tensile strength without any special sacrifice except the patient's comfort. It would perhaps be better not to use it in the mouths of nervous or timid patients. It is suggested that in the mouths of patients who use their teeth vigorously, after enough gold has been condensed in the step portion to act as a cushion, the mechanical mallet be used for the remainder of the step portion, not only to save a little time, but also, and mainly, to increase the strength of that part of the filling. Where this is done and gold and platinum are used for that part, the step portion of the cavity may be kept somewhat narrower than would otherwise be safe.

COMMENT

In the discussion of methods of condensation, I have indicated that the method of hand pressure alone, if thorough, is slow and tedious. It has also been shown that in the method of hand pressure combined with hand mallet force, the mallet being used by an assistant, versus the mechanical mallet, the former gives the greater hardness, while the latter increases the tensile strength somewhat and is more rapid. It is my opinion, based on long clinical experience as well as the results of the present investigation, that the combination of hand pressure and use of a suitable hand mallet by an assistant gives better control of the lines of force and a better use of the wedging principle, is much easier on the patient and is by no means a slow method if properly learned. Very large restora-

tions are now usually made with the inlay rather than foil; which makes the extreme speed of the mechanical mallet of less importance.

SUGGESTIONS TO MANUFACTURERS

The deductions of this investigation are that the advantages of platinum-centered gold foil, i.e., increased hardness and tensile strength and decreased elongation under tension, are, operating conditions being equal, proportionate to the platinum content. It would seem that from 25 to 30 per cent platinum would give the desired result without increasing any of the disadvantages over a smaller platinum content foil.

Under the paragraph on cohesion, it is suggested that the probable cause of certain relatively weak areas is the extreme thinness of the layer of pure gold covering the platinum and its thus having a tendency to burn off in the annealing. A probable remedy for this would be to beat out the foil to about a No. 6 instead of a No. 4, thus leaving a somewhat heavier covering of gold over the platinum. The dentist also should use special care in annealing not to overheat the pellets. Such a foil would probably show a greater tensile strength than what we are now using.

CONCLUSIONS AND SUMMARY

The progress of this investigation to date bears out the conclusions suggested in the earlier report and confirms the inferences of clinical experience.

While actual flow tests have not been made, the increased hardness and strength and the low percentage of elongation show quite conclusively that fillings made of the platinum-centered gold foil will be more resistant to wear and less subject to flow under pounding stress.

At present the following conclusions may be drawn:

In platinum-centered gold foil, the platinum in any percentage increases the hardness, tensile strength and resistance to wear, and decreases the tendency to stretch or flow under stress, and these effects are proportionate to the percentage of platinum contained.

When the gold and platinum foil is beaten out to a No. 4 thickness, the gold is left so thin as to have a tendency to burn off in the annealing and thus some weakened areas are probably left in the filling.

The hardness and strength of any of the materials tested is increased by care and thoroughness in stepping the condenser, by heavier condensation and by use of a condenser which is not too large.

The size of the condenser is important in proportion as hardness, density and strength are important.

The use of the electric or mechanical mallet tends to produce a filling with somewhat higher tensile strength than other methods of condensation, but is otherwise undesirable.

Pure gold makes an entirely satisfactory filling when properly handled except when special hardness is desired.

The crystal gold investigated is an unsatisfactory material for use if the best results are desired.

Foils of such thickness as will permit of ready adaptation to the cavity walls are the most satisfactory form of gold for filling purposes.

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PROPERTIES AND MICROSCOPIC STRUCTURE OF GOLD AND GOLD-PLATINUM FOILS*

By JOHN S. SHELL, B.S., M.A., San Francisco, Calif.

THE physical properties and microscopic structure of gold foil have not been entirely overlooked in the recent trend toward standardization of dental materials, but the data have been relatively meager and occasionally misleading.[1] In the voluminous literature pertaining to gold foil, a few authors have published data[2] on the mechanical properties, but comparison of foil fillings with other types of restorations has been largely subjective.

The data reported by Rule[3] are a distinct contribution to this field of dentistry, as they indicate not so much the conditions which are present in the average gold foil filling as the conditions which may be approached in such restorations. The comparison between gold foil, gold-platinum foil, mat gold and "crystal gold" is especially significant. In Dr. Rule's paper, the clinical aspects are stressed, while in this discussion the metallographic properties are considered.

SIGNIFICANCE OF TESTS

It has generally been considered that the most important mechanical properties of gold foils are hardness and flow, but it is possible that tensile strength, impact strength, elongation and elasticity are equally important in determining the value of a foil filling in dental practice. Adaptability and cohesion have been recognized as primary requisites of gold foil, but no adequate methods of testing these properties have been developed. They can be estimated subjectively, and qualitative information of this nature is often of great value in determination of the better products on the market.

The hardness of a material provides a rough indication of the wearing quality; and the flow, as generally measured, indicates the amount of deformation under a constant continual pressure. The tensile strength test may give information regarding the total amount of stress which a foil filling can withstand in a longitudinal direction without fracture. Failures of this type observed in foil fillings are probably the result of loss of cohesion rather than an indication of insufficient tensile strength inherent in the material. Elongation data give an indication of the amount of deformation which may be produced before fracture occurs. The method used in determining the elongation, especially the rate at which the specimen is broken, will probably have a decided effect on the values obtained.

Density determinations are valuable as an indication of the presence of voids or air spaces within the specimen.

METHODS OF TESTING

The Brinell hardness was determined by using the initial 10 kg. load of a "Rockwell Hardness Tester" with a one-sixteenth inch ball for a period of thirty seconds. The diameter was measured by a micrometer microscope and the hard-

*Contribution from the Division of Physical Sciences, College of Dentistry, University of California.

ness calculated by the standard Brinell formula.

The tensile strength tests were made on a small Olsen testing machine, using a counter balance equivalent to 1,000 pounds for the entire lever length. The specimens were turned down in the center on a lathe for a length of about 7 mm. to a diameter of 1.25 mm. from the original specimen, which measured 10 by 1.5 by 1.5 mm. The values for tensile strength were then calculated in pounds per square inch.

The elongation was determined by measuring the total length of the specimen before and after testing and calculating on the basis of per cent of increase in length. The broken ends of the gold specimens could usually be fitted together fairly well to give satisfactory readings, but many of the gold-platinum specimens showed a longitudinal fracture for a length of from 2 to 2.5 mm., which prevented accurate readings of the length after breaking. Elongation measurements of this nature on such short specimens are not very accurate, but the difference in elongation between the pure gold and the gold-platinum foil is undoubtedly significant.

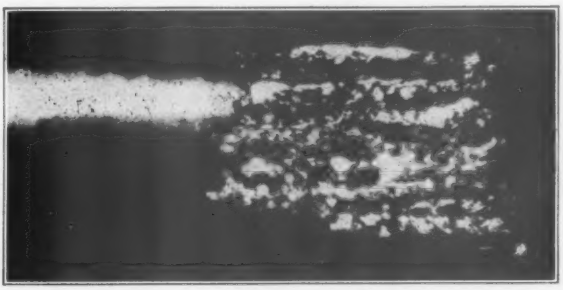

Fig. 1.—Fractured section of 40 per cent platinum foil broken in tensile strength test. Part of the original bar which was turned down on the lathe is shown on the left. The right side of the picture shows the area of fracture resulting from loss of cohesion. (×25.)

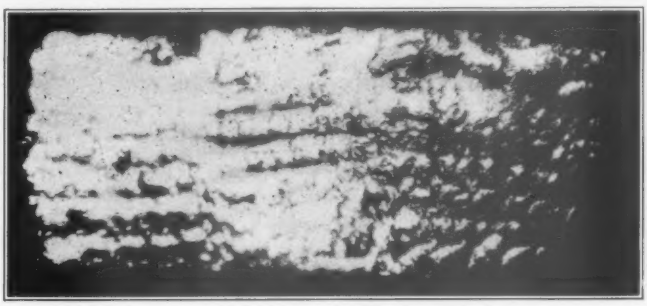

Fig. 2.—Fractured area of 15 per cent platinum foil. The results of "stepping" during condensation can be observed. This area exceeds 3 mm. in length and developed near the maximum diameter of the specimen. (×25.)

The density was determined by weighing in air and in methylene iodide at a constant temperature. The liquid had a density of 3.32 gm. per cubic centimeter. The use of a liquid of high density as compared with water increased the ease and accuracy of the density determination. This method is valuable only in determining internal imperfection and does not tell anything about the surface irregularities. As the foil was packed against the machined surface of a steel die, it was felt that the adaptation to the walls of the die might not be comparable to that obtained in packing against the walls of a cavity in a tooth. A satisfactory objective test for adaptation to the walls of tooth structure would be valuable in determining the relative merit of different materials and different technical procedures.

DATA

The average Brinell hardness of the pure gold foil specimens is 54. This is approximately equivalent to the hardness of a 22-carat gold-copper-silver alloy containing 4 per cent copper. As the range of hardness of the soft inlay gold specified by the Bureau of Standards[4] is 40 to 75, it is apparent that the hardness of these foil specimens is in the lower range of the soft casting alloys. These specimens were prepared in a steel die by

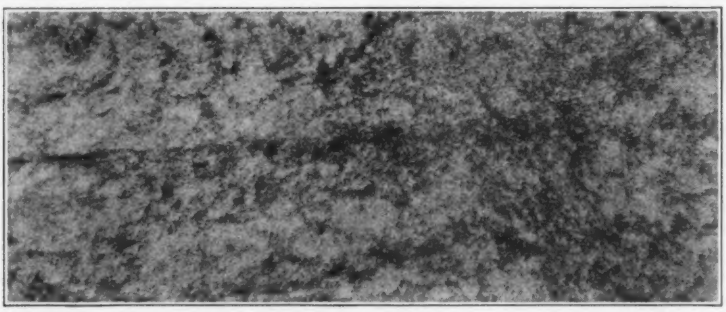

Fig. 3.—Pure gold foil. (×25.)

Fig. 4.—"Crystal gold." (×25.)

a trained operator, and both of these facts would tend to explain the greater than average hardness of a sample of foil.

The average Brinell hardness of the gold-platinum foils is considerably higher than that of the pure gold specimens. A value of 78 for the average of the 10 and 15 per cent platinum foils is above the hardness range of the softer casting alloy and falls within the range (70-100) designated as Type B, or medium hard materials. The average for the 30 and 40 per cent platinum foils (96) places these in the lower range of the Type C (90-140) hard gold alloys. The three highest hardness values attained (110-106-103) indicate the possibility of producing a foil filling above the medium hardness of casting alloys, although it should be remembered that these samples were not prepared in the mouth.

The average of the tensile strength tests is much higher than would normally be expected from this type of material. An average of 36,000 pounds per square inch for pure gold is higher than the values obtained from many soft casting alloys recommended for inlays and compares favorably with the tensile strength of some alloys recommended by manufacturers for the preparation of crowns. The average strength of the gold-platinum foils containing 10 and 15 per cent platinum (45,000 pounds per square inch) is as high as that reported for many cast crown alloys, and occasionally metals are recommended for cast dentures and saddles which show lower values for the property. The 30 and 40 per cent platinum foils give an even higher tensile strength, with an average of 50,000 pounds per square inch and a maximum of 59,000 pounds per square inch; which indicates the possibility of producing high-strength foil specimens.

The gold-platinum foils often showed

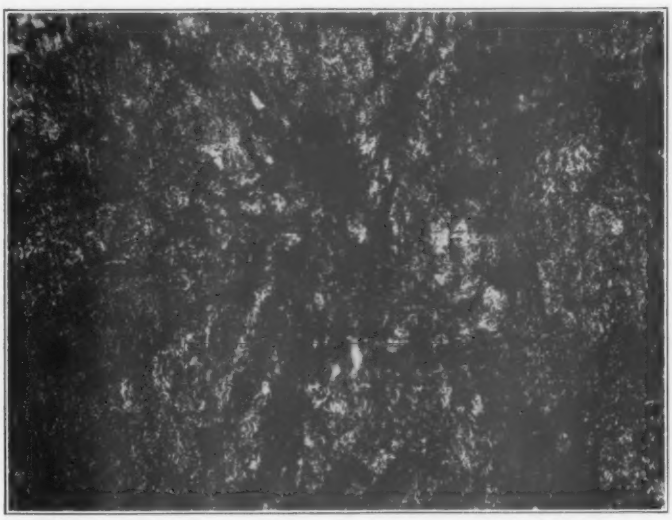

Fig. 5.—Pure gold foil. Alternating dark and light areas were caused by irregularities in condensation. (×500.)

a failure during tensile strength testing, which indicated a loss of cohesion in a plane parallel to the direction of stress, as opposed to the gold specimens, which usually broke with the normal transverse fracture after an appreciable necking break just before failure. This seems to indicate that even higher tensile strength could be obtained if these planes of weakness could be eliminated. Low power photomicrographs of such areas indicate the structure which seems favorable to fracture. These areas are not flat, and it was impossible to obtain pictures in which the entire area was in sharp focus. Figure 1, from specimen F-2 (40 per cent platinum), shows the end of the unfractured bar near the junction with the fractured area. This specimen had the greatest tensile strength (59,000 pounds per square inch). The surface showed patches of platinum-colored metal, indicating that gold has been removed from the surface or that the platinum had diffused into the gold sufficiently to color it. The gold surface may have been removed either during annealing or during condensing. In Figure 2 (specimen G-2, 15 per cent platinum), the platinum-colored areas were also in evidence. In this picture, the fracture surface is shown and the layers in which the foil was laid down during condensing are in evidence.

The elongation data are rather meager, but sufficient to indicate that even a small platinum content reduces the value for this property by about 50 per cent. The average density of the gold specimens is 19.1 gm. per cubic centimeter as compared with 19.32 for the reported density of pure gold. This is approximately 98.9 per cent of the density of the pure metal. The average density of the 10 per cent platinum foil is 19.5, which is almost identical with the calculated density of a mixture of 90 per cent gold and 10 per cent platinum based on the value of 19.32 for the density of gold and 21.45[5] for

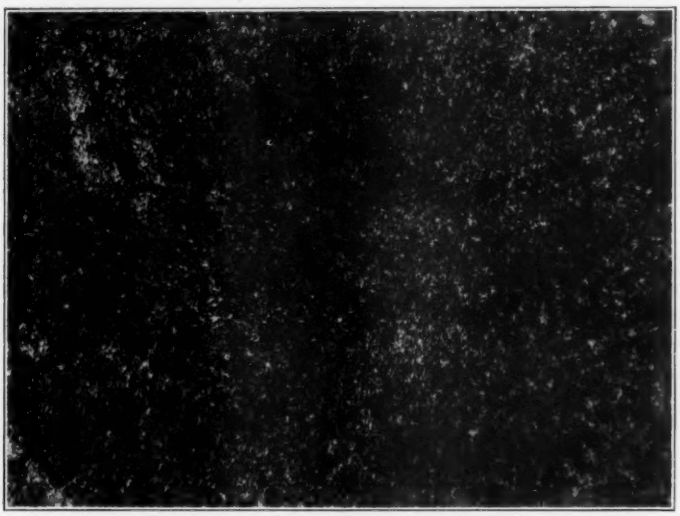

Fig. 6.—"Crystal gold." (×500.)

the density of platinum. The calculated density for the 15 per cent platinum foil is 19.64; while the average density obtained from these foils is 19.5, or 99.3 per cent. No data are available on the density of the 30 per cent platinum foils, but the 40 per cent foils show an average value of 19.81 as compared with a calculated value of 20.17, or 98.2 per cent. Analyses of these foils check the manufacturers' quotations closely enough to warrant the calculations shown in the accompanying table.

From these data, it can be seen that the average density obtained from each group of foils approached the reported or calculated density. This would seem to indicate that the higher platinum foils were condensed as well as the pure gold specimens. The value of 98.9 per cent for the pure gold as compared with 98.2 for the 40 per cent platinum products hardly seems significant in view of the experimental error. An alloying effect resulting from diffusion may be more pronounced in the higher platinum foils so that the calculated density may not represent the actual density of the final product.

	100% Gold	90% Gold 10% Platinum	85% Gold 15% Platinum	60% Gold 40% Platinum
Observed density	19.1	19.5	19.5	19.8
Calculated density	19.32	19.53	19.64	20.17
Calculated density (percentage)	98.9	99.9	99.3	98.2

MICROSTRUCTURE OF GOLD AND GOLD-PLATINUM FOILS

Microscopic examination of polished and etched gold foil specimens is useful in comparing the structure of different materials and in evaluating the different methods of condensation. When these are correlated with the data on physical properties, predictions may be offered regarding the possibilities of improving the properties by changing the structure.

For such a comparison, four pictures, Figures 3, 4, 5 and 6, have been prepared. Figures 3 and 5 are obtained from pure gold foil and Figures 4 and 6 show the structure of a "crystal gold." Figures 3 and 4 are taken at a magnification of 25 diameters. The pure gold foil (Fig. 3) does not show a completely homogeneous structure, but does not exhibit gross imperfections. The series of steps introduced during condensation are apparent and a line through the center indicates irregular condensation in that plane. This specimen showed a tensile strength in excess of 35,000 pounds per square inch.

Figure 4, showing the structure of a "crystal gold" at the same magnification (×25), indicates some irregularities, largely in the nature of small dark areas. No suggestion of lack of cohesion or irregular condensation can be observed. Pits or gross imperfections are entirely absent, yet the sample was so weak that it could be crumpled in the fingers and no tensile strength specimen could be prepared.

The comparison of Figures 5 and 6 is even more significant. Figure 5 shows the structure of a pure gold foil at a magnification of 500 diameters. The dark area in the center indicates irregular condensation and the entire surface of the specimen was covered with such irregularities. The sample of "crystal gold" shown in Figure 6 is regular and the entire surface of the specimen was almost

free from imperfections. When the structures are compared, the advantage is all in favor of the crystal gold, but when the physical properties are compared, the gold foil is superior.

It is apparently a simple matter to prepare a specimen of "crystal gold" with a homogeneous structure, and little improvement in properties can be expected from further condensation. The preparation of a homogeneous microscopic structure in gold foil is extremely difficult and probably impossible in practice, but the physical properties of an imperfect foil filling are much better than of a "crystal gold" with an homogeneous structure. The attainment of a perfect structure in gold foil has probably not been reached and every step in that direction should improve the physical properties.

Figure 7 (×500) shows the structure of the gold platinum foils containing 40 per cent platinum. This structure is similar to that of the pure gold foil. Figure 8 (×200) shows the structure of a mat gold and can be compared to the gold and gold platinum foils, although the magnification is much lower.

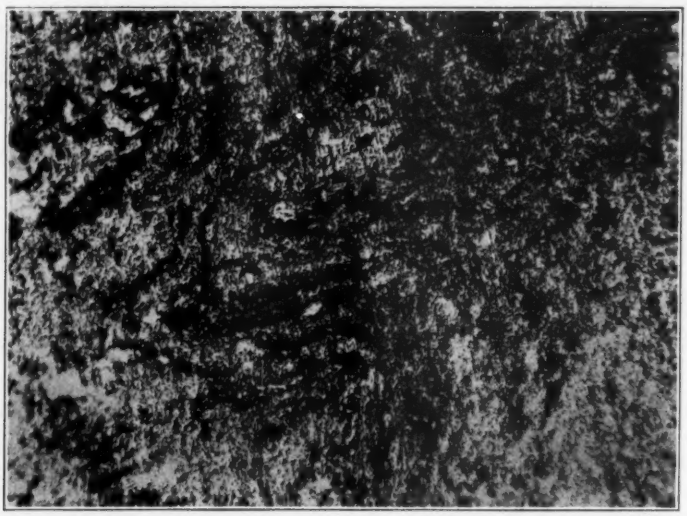

Fig. 7.—Gold platinum foil (40 per cent platinum). (×500.)

SUMMARY

As regards the significance of the various tests on the physical properties, discussed from the standpoint of gold foil fillings, it is difficult to decide which properties are most important in determining the value of gold foil. The development of a standard adaptation test is imperative.

In the discussion of the data reported by Rule, emphasis is placed on the fact that the tests were made on specimens prepared in steel dies and not in cavities in the teeth.

The average Brinell hardness of pure gold foil is comparable to that of soft cast inlay gold alloys. Platinum increases the hardness and specimens have been prepared with a value over Brinell 100.

The tensile strength tests produced higher values than would be expected from foil fillings. Failure in the gold-platinum specimen frequently occurred through a longitudinal fracture, indicating a plane of imperfect cohesion.

Density determination showed that all of the foils approached the density of the materials used, indicating an equivalent amount of condensation in all types of foil.

A correlation of microstructure and physical properties of gold foil and "crystal gold" indicates that greater hardness and strength can be expected from foils.

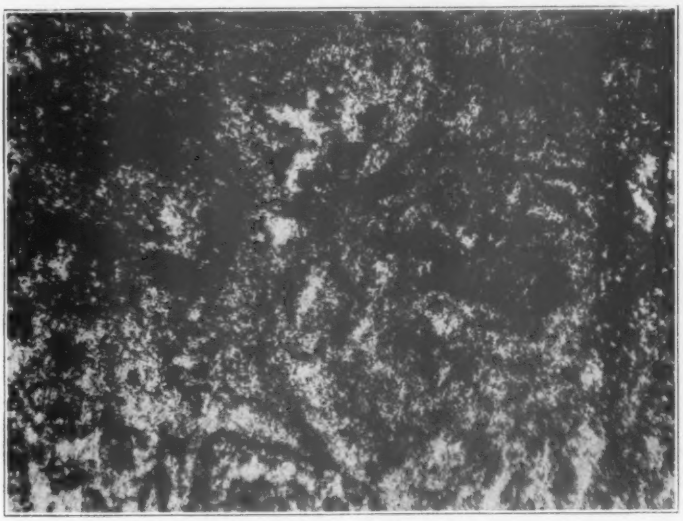

Fig. 8.—Mat gold. (×200.)

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A MASTER MANDIBULAR IMPRESSION SHOWING MAXIMUM RETENTION AND STABILITY AND REQUIRING NO REBASING*

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AN intimate knowledge of the anatomy of the mouth is a prerequisite to the building of a satisfactory denture. It is even more important as regards the lower denture.

We are indebted to those men who have emphasized the value of a knowledge of anatomy in full denture prosthesis. I am speaking not for the recognized specialist of long standing, who has had opportunities for research and practical experience, which has taught him many things, but for the average small town practitioner, who, after all, builds the majority of the dentures in the country.

The technic that I am describing here has been used for nearly five years. During that time, more than 100 cases have been constructed and the end results invariably have demonstrated its value. It is not all the original idea of one man, but has been developed by applying the ideas of several men over a period of years. It has been more a process of evolution of ideas without radically discarding all that has been learned before and trying something new. Undoubtedly, many are familiar with certain of the ideas and may have used them.

There are certain general features which should be taken into consideration before an attempt is made to build dentures.

Impression taking and pouring of models are followed by registration of an ordinary centric relationship with wax bite-blocks and carding wax. The teeth are set up on a plain line articulator. The only things of importance at this stage are esthetics and the amount the bite is to be opened. Modeling compound bite-blocks are built over base-plates and these lined with paraffin. Stansbery check bite-plates are then adjusted and true centric, lateral and protrusive records taken in soft plaster. With these records, the case is then mounted on an adjustable articulator. Condyle paths are set from plaster check-bites. The teeth are then perfectly balanced and the case is ready for the vulcanizer. Prior to the last mounting, the casts are notched so that tin-foil placed back of the casts can be removed after vulcanization and the case returned to the articulator and remounted for milling.

In milling in the case, a small stone is used and the teeth are spot ground very carefully. Grinding is done on the lingual slope of the buccal cusps of the upper and the buccal slope of the lingual cusps of the lower. Great care is observed not to destroy the tips of cusps, if necessary the marginal ridges being sacrificed. No mechanical milling machine is used. By this method, there is no

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radical loss of anatomic structure, and we have a glazed and a ground surface functioning together for greater efficiency. The plates are then removed from the original casts and trimmed and polished.

With a lower denture covering the area, it is possible to open a bite to a marked extent and thus restore facial contour and improve the profile. Figure 1 shows the size of the lower denture used in this case as compared to the size of the one the patient was wearing. The large plate has been comfortably worn for more than a year. Figure 2 shows the facial contour before and after insertion of the new denture.

It is always wise to classify the patient as to the mental attitude toward dentures. I have made it the rule to explain, that in order to build satisfactory dentures, I must have the patient's utmost cooperation. Together, we can construct this case, but if either one of us fails to cooperate, all efforts are usually in vain. Having secured that promise of cooperation, I am ready to proceed.

Fig. 1.—New denture (left) as compared in size with old (right).

A roentgenogram is usually taken to determine whether there are any fragments of roots or unerupted teeth present. Also, it is well to know the quality of bone to be dealt with. The type of bone found in pyorrhea cases usually means rapid absorption under a denture and changes in the denture will be required in much less than the usual time. In this type of case, there is usually a very definite lack of calcium.

In normally calcified bone, when teeth have been lost, usually from excessive decay, but seldom from pyorrhea, there is less change to be dealt with later. While a great deal is not known about calcium metabolism, I have found, in the past twelve years, that there is very definite help to be obtained by placing the patient on a diet of calcium and capsules of cod-

Fig. 2.—Appearance of patient before (left) and after (right) restoration of facial contour by opening of bite. The denture shown in Figure 1, left, was made for this case.

liver oil. It seems to allow the sockets, even in pyorrhea cases, to fill in more quickly with good bony structure. This treatment has been found valuable even prior to extraction of teeth. It has been routine practice in my office for several years to place the patient on this form of

treatment before extraction and to continue it for several months after the dentures are completed. In a series of more than 200 test cases, I have had ample proof of the difference it makes in the reaction to extraction, rapidity of healing and the general health of the patient through the whole procedure.

ARCH SIZE AS COMPARED TO SIZE OF DENTURE

Arches are classified according to size as large, medium and small. Usually a large arch makes for much greater stability and retention. The actual size a lower denture (Fig. 3) can be as compared to the arch is sometimes a source of surprise. We are all agreed that the greater the area covered by a lower denture, in other words, the larger the denture, the greater the retention and stability. But the denture must not interfere with the normal function of any muscle of the lips, cheeks, tongue or floor of mouth, nor irritate the border tissue attachments. Also, we know that the pressure per square millimeter will be inversely proportional to the size of the denture. Therefore, the larger this denture can be built, the less change there will be as the case is worn.

Fig. 3.—Denture of increased size (left) which afforded greatly increased stability and retention.

Fig. 4.—Tray made with curved handle to allow sucking motion of lips.

We have been well taught, as to the stress-bearing areas of the lower denture, the marginal limitations of the denture from an anatomic standpoint, but we have overlooked the functional movements and toleration of certain areas, particularly the mylohyoid muscle, which forms the floor of the mouth.

Fig. 5.—Snap impression.

Fig. 6.—Muscle-trimmed lingual borders.

RIDGE FORM

Would a contractor deliberately build

a foundation around a growing root of a tree, or care whether the foundation was straight before erecting a house?

In a patient, aged 65, the teeth had been out for ten years. Two sets of dentures had been made, but she was unable to wear the lower denture of either set. The dentist and the family chided her continually for her failure to cooperate. An examination last fall revealed that the crest of the anterior ridge was considerably broader than the base of the ridge near the border tissue attachments. The plate was not elastic. Any plate small enough to fit at the border tissue attachments certainly would be too small to go over the crest of the ridge. Any plate large enough to go over the crest of the ridge certainly would not fit the border tissue attachments. Surgical measures were required, almost 3 mm. of bone being removed in order to assure a well-rounded ridge with a broad crest and no undercuts.

Two weeks later, complete dentures were made and, during the following week, the patient ate every meal with the dentures in place. Why are we so hesitant about carrying out the simple surgical measures that are necessary to create the right type of condition? Certainly, it is always advisable to remove any sharp ridges of bone or sharp spines, which will always be sore and feel like a sliver in the finger under pressure.

We are not so concerned with lateral throat form conditions as formerly. Of course, a Class 1, or ideal, throat form is an advantage in any case, but, by making use of extensions under the tongue, it is possible to increase retention even in Class 3 throat form areas.

Tissue tone will make a considerable difference in the amount of extension of the lower denture. A low tissue tone or one in which muscles function very weakly will tolerate comfortably a little more extension. In fact, it is very easy in these cases to lose retention by underextension, as the border tissue attachments will require a little more pressure.

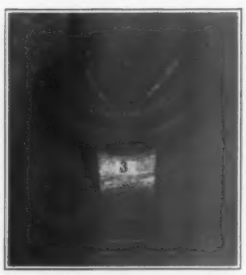

Fig. 7.—Muscle-trimmed buccal and labial borders.

Fig. 8.—Completely muscle-trimmed impression ready for paraffin lining.

In this type of case, I use a slightly lower fusing paraffin for the final impression, in order not to extend it beyond the margin of safety, and yet secure positive contact of the border tissue attachments. A case with high tissue tone will usually mold the paraffin with ease. Great care must be taken here not to overextend, as this will result in much soreness and a lack of stability. Thickness of the tissue covering the ridge is also important. The ridge that has only a very thin covering of mucosa will give more trouble with any technic. Again, the greater the size, the less the pressure

per square millimeter. Salivary conditions also help determine results. Dryness of the mouth usually lessens retention and causes soreness. A thick viscid saliva is also detrimental.

In this technic, the size and shape of the tongue are important. We know that the tongue enlarges some when just one molar tooth is lost and not replaced. The person who has lost most of the molars years before usually has a very definite broadening of the tongue at the base. If the tongue is confined, it will shrink in time, although there will be more awkwardness for this patient in wearing dentures at first than for the person who has not experienced this change. That is certainly a good reason for not allowing a patient to go any length of time without teeth. The functional extension for the broad, short tongue is approximately one-fourth inch beyond the red line of the lips. For the long narrow tongue, it is approximately one-half inch.

Here, then, is a surprising statement. More freedom of the tongue is possible with this additional extension on dentures, and without dislodging the denture, than was formerly the case when the denture was limited to the mylohyoid ridge.

Fig. 9.—Completed lower impression.

SELECTION OF TRAY (FIG. 4)

A tray of the approximate size and shape of the arch is selected and trimmed short of all muscle and tissue attachments. It must be large enough to carry the compound to the retromolar triangular pad. It need not extend lingually any great depth. The only use here for a tray is as a means of carrying the compound to place the first time and to serve as a handle for the impression. The handle of the tray is curved upward and out to allow room for the lips to form a seal around it in a sucking motion.

IMPRESSION TECHNIC

After the tray is trimmed and smooth, we are ready to proceed with the compound impression. A fairly large roll of compound is softened in hot water and fitted into the tray. As the tray is inserted and gradually seated over the ridge, the patient is asked to extend the tongue toward the roof of the mouth and move it gently from side to side. This allows the compound to slip down underneath the tongue and over the floor of the mouth. The patient is then asked to close and suck on the handle without too much force. The compound is chilled and removed. On examination of the im-

Fig. 10.—Completed lower master impression.

pression (Fig. 5), there should be ample extension on the lingual border, and particularly into the throat areas.

MUSCLE TRIMMING OF THE LINGUAL BORDERS (FIG. 6)

We are now ready to proceed with the muscle trimming of the lingual borders. Taking one side of the lingual flange distally, from the first bicuspid area to the throat flange area, the operator heats only the tissue side of the impression from the mylohyoid ridge downward. The impression is then tempered in water about 120 F. and placed in the mouth. The patient is asked to protrude the tongue as far as possible, and the im-

Fig. 11.—Case in which alveolar ridge was absent, yet patient wore large denture shown in Figure 3.

pression is chilled and removed. It will be noted that the compound has literally rolled out over the lingual border. (The compound must not be heated entirely through, as the tongue would immediately bend up the entire lingual flange.) The same procedure is followed on the opposite side. Next, the anterior area is heated over the lingual frenum from bicuspid to bicuspid. This area can be heated considerably more than the posterior section of the lingual flange. The impression is tempered and inserted in the mouth. The patient is asked to move the tongue toward the roof of the mouth and then outward as far as possible.

We are now ready to trim the throat flange areas. The distal edge of the lingual flange is heated to the molding stage and the patient is again asked to protrude the tongue as far as possible. It is not possible at first to complete entirely one section before proceeding to another. It is well to trim the whole lingual border gradually, going from one section to another until the tongue can protrude from one-fourth to one-half inch beyond the red line of the lips and also can reach over into the vestibule on both sides as though cleaning out food. This insures the tongue all the freedom it needs for functional movements. The patient will invariably tell the operator when he is interfering with the movements of the tongue. The tissue side of both lingual flanges is heated carefully, tempered and placed in the mouth. The thumb is placed just distally to the anterior ridge and the patient is asked to push the thumb out of the mouth with the tongue. This allows the tongue to thicken at its base and assures additional room.

MUSCLE TRIMMING OF BUCCAL AND LABIAL BORDERS (FIG. 7)

Starting with one buccal flange, the operator heats a section of that flange forward as far as the buccal frenum. This area should be heated entirely through the compound to a molding stage, the compound then being tempered in warm water. It is replaced in the mouth and the patient is asked to close in a sucking motion over the handle of the tray. It is well at first to assist by molding with the finger on the outside of the cheek. The compound is chilled and removed, some of the excess is trimmed away, and it is reheated, the operation being repeated until the excess is removed. The action

of the muscles in the sucking motion will eventually determine the extension buccally in this area.

The operation is repeated on the opposite side of the lower denture. I have on occasion arbitrarily cut this margin short, leaving a sufficient thickness of compound. On heating and replacing in the mouth, the sucking motion has re-extended the margin back to its original length. The labial portion between the two buccal frena is heated to molding stage, tempered and replaced in the mouth, and the patient is asked to repeat the sucking motion. The compound is chilled and removed.

For the two buccal frena, it is well to heat each small section alone, one at a time and, on placing the impression in the mouth, hold the impression down firmly, and pull the buccal frenum up in order to allow additional play for this attachment. This is the muscle that usually allows the denture to lift when the mouth is opened wide. The impression is now ready for the paraffin lining. (Fig. 8.)

PARAFFIN LINING (FIG. 9)

The paraffin lining gives detail with a material that can be molded nicely at mouth temperature. Also, placing it correctly helps place pressure over the stress-bearing areas. The impression is dried thoroughly. The paraffin is heated in a double boiler and, with a camel's hair brush, the impression is painted carefully as follows: From 1 to 2 mm. of paraffin is built up on the tissue side of the buccal and lingual flanges extending from the border of the flange to within approximately 2 mm. of the crest of the ridge. The margins of the impression are well covered also. No paraffin is placed on the crest of the ridge. Approximately 2 mm. of paraffin is placed over the distal border of the retromolar triangular area and the lateral throat form area. The impression is tempered in water at approximately 115 F. and then is gradually seated in the mouth with very slight pressure.

At this point, sufficient time should be taken to allow the paraffin to gradually flow to place. Muscle trimming is not to be attempted for at least ten minutes. The paraffin will slowly flow from the base of the ridge toward the crest and also out over the margins. When the impression is thoroughly seated, the patient is instructed to make all movements of the tongue and asked to swallow several times and also suck hard on the handle of the tray. Holding the tray securely down, the operator uses a little torsion on the impression to relieve any sharp bony areas in the region of the mylohyoid ridge. The impression is chilled and removed and we have a completed lower master impression (Fig. 10), which, if directions have been followed closely, will give maximum retention and a great stability.

In finishing, the lingual flange can be cupped out on the lingual side so as to give a natural place for the tongue to lie in and increase its space. Protrusion of the tongue in these cases only serves to increase retention. Often, it is well nigh impossible to dislodge the denture when the tongue is protruded slightly. If the patient deliberately relaxes the tongue and draws it back in the throat, the denture will loosen easily. The tip of the tongue at rest lies against the lingual surface of lower incisors and in that position there is marked retention. Drawing the tongue back to loosen the denture has to be a deliberate voluntary action of the patient and is not classified as a functional movement.

Over a period of years, I have tried several types of lower dentures. I have, on several occasions, rebuilt other lower

dentures into one of these dentures. I mean dentures that were ordinarily satisfactory. I have been gratified to have the patient advise me of a great increase in stability, retention and comfort.

This technic has been of great assistance in cases wherein the alveolar ridge had almost completely disappeared. Figure 11 shows an absence of the alveolar ridge, yet the patient wore the large denture shown in Figure 3. I have seen far less discomfort and soreness in completed cases than ever before, with any type of lower denture, and the patient has learned to eat and talk much more rapidly. Few adjustments have been required and the amount of trimming has been very slight. In some cases, I have not had to touch the lower denture after completion.

SUMMARY

1. It is entirely possible to rebuild a satisfactory lower denture in one vulcanization.

2. Cooperation of the patient is essential.

3. Roentgenograms are desirable.

4. Compound is actually developed into an accurate fitting tray, which is lined with paraffin.

5. The lower denture is much larger than with the usual technic.

6. Cases require the minimum amount of adjustment after finishing.

7. The finished case has suction and great stability.

8. This technic is employed with great satisfaction in the case that has no alveolar ridges.

1107 Equitable Building.

STERILITY OF LOCAL ANESTHETIC SOLUTIONS IN AMPULES

By LOUIS I. GROSSMAN, D.D.S., Dr. med. dent. (Rostock), and J. L. T. APPLETON, B.S., D.D.S., Sc.D., Philadelphia, Pa.

IN the public interest, it seems desirable to have independent bacteriologic examinations made, from time to time, of of the contents of ampules of local anesthetic solutions offered to the profession. This was done at the instance of Samuel M. Gordon, secretary of the Council on Dental Therapeutics of the American Dental Association.

The preparations examined are given in the accompanying list. The formulas, in some instances, have been changed since the tests were made, but there is little reason to believe that the methods for obtaining and maintaining sterility have been altered.

Some steps have been taken[1] toward standardization of a method of determining the sterility of the contents of ampules. Practice along this line has not yet so definitely crystallized that departures therefrom are inadvisable. Consequently, we have developed our own procedure, which is by no means less rigorous than other procedures previously advocated. We have tested the samples at our disposal both culturally and by animal inoculation. Four media were used: (1) nutrient beef-extract broth, p_H 7.6, for the ordinary bacteria including the pyogenic staphylococci and the anthrax bacillus; (2) a "hormone" broth[2] for streptococci; (3) a chopped meat (beef muscle or liver), 1 per cent

glucose broth for anaerobes; e.g., the tetanus bacillus and the organisms of gas gangrene, and (4) Sabouraud's medium for yeast and molds. The third medium was prepared by putting the glucose broth into tall tubes. Into each of these was put about 1 gm. of the chopped meat. Immediately after inoculation, the medium was covered with sterile white petrolatum to a depth of about 4 cm.

The ampules were first centrifuged. After they were opened aseptically, 15 drops from the lowest stratum were inoculated into each tube of medium. These tubes were incubated at 37 C., for at least seventy-two hours before a negative result was recorded.

In the ordinary broth, the "hormone" broth, and in Sabouraud's medium, a yeast developed in the tubes inoculated with anesthetics Nos. 2, 3 and 34. In the "hormone" broth tube inoculated with anesthetic No. 50, there appeared a nonmotile gram-positive rod. All other cultures showed no growth.

The sterility of the samples was also determined by animal inoculation. Into each of two white mice, 0.1 cc. of a sample was injected subcutaneously at the base of the tail. This was done especially to reveal the bacilli of anthrax, tetanus or gas gangrene. Mice dying after this injection or surviving six days came to necropsy and cultures were taken (1) from the heart's blood onto an agar slant and (2) from the site of injection into the chopped meat broth mentioned above for anaerobes.

In three instances, the heart blood culture was positive; and, in three other instances, growth was obtained in the medium inoculated from the site of injection. These six positive results were obtained from six different mice, no two of which had been injected with the same anesthetic. In other words, a positive result in one mouse was not corroborated by a positive result in the other mouse that was injected with the same anesthetic.

There was certainly no convincing evidence that the six organisms isolated had been originally present in the anesthetic. We are inclined to regard them as contaminants. It is certain—and it is this that is really important—that anthrax, tetanus or gas gangrene bacilli were in no instance isolated from any of the anesthetics tested. None of the six organisms isolated belonged to species pathogenic for man. Beyond that, no attempt was made to identify them.

In brief, from none of the fifty-one local anesthetic solutions examined were pyogenic cocci, streptococci or the bacilli of anthrax, tetanus or gas gangrene isolated.

The possible significance of the yeasts deserves consideration. Their development on three of the four media inoculated makes it unlikely that the technic was at fault. They probably were actually in the anesthetics in question. While they were found in only three of fifty-one ampules examined by us, it must be remembered that hundreds of thousands of ampules of procaine solution are used annually by the dental profession. It is therefore gratifying to learn from a recent report[3] of the Council on Dental Therapeutics of the American Dental Association that the manufacturer will be required to submit evidence that the procaine solution is sterile when released to the consumer before that product will be eligible for acceptance by the Council.

Yeast infections about the jaws have been reported as following the injection of local anesthetics.[4] The yeast may have been in the anesthetic, or it may have been on the oral mucosa, whence by needle puncture it was carried into the deeper tissues.[5]

List of Procaine Solutions Examined for Sterility

No.	Manufacturer	Description	Formula	Age Months
1	Novocol Co.	Novampul	0	8
2	Novocol Co.	Novampul	1	11
3	Novocol Co.	Novampul	2	11
4	Novocol Co.	Novampul	3	11
5	Novocol Co.	Novol ampule	0	11
6	Novocol Co.	Novol ampule	1	14
7	Novocol Co.	Novol ampule	2	14
8	Novocol Co.	Novol ampule	3	14
32	Novocol Co.	Novol 2-ounce bottle	No epinephrine	10
33	Novocol Co.	Novol 2-ounce bottle	No epinephrine	10
34	Novocol Co.	Novol anestube	0	13
35	Novocol Co.	Novol anestube	1	15
36	Novocol Co.	Novol anestube	2	16
37	Novocol Co.	Novol anestube	3	16
38	Novocol Co.	Novol anestube	0	11
39	Novocol Co.	Novol anestube	1	16
40	Novocol Co.	Novol anestube	2	14
41	Novocol Co.	Novol anestube	3	14
42	Novocol Co.	Novol ampule	1	14
43	Novocol Co.	Novol ampule	2	14
44	Novocol Co.	Novol ampule	3	14
9	Cook Laboratories, Inc.	Carpule	No epinephrine	8
10	Cook Laboratories, Inc.	Carpule	AB	8
11	Cook Laboratories, Inc.	Ampule	AB	8
12	Cook Laboratories, Inc.	Carpule	A	8
13	Waite (Antidolor Co.)	Carpule type	No epinephrine	8
14	Waite (Antidolor Co.)	Carpule type	2	8
15	Waite (Antidolor Co.)	Carpule type	4	8
16	Waite (Antidolor Co.)	Ampule	No epinephrine	8
17	Waite (Antidolor Co.)	Ampule	2	8
18	Waite (Antidolor Co.)	Ampule	4	8
19	Waite (Antidolor Co.)	2-ounce bottle	No epinephrine	8
20	Waite (Antidolor Co.)	2-ounce bottle	2	8
21	Waite (Antidolor Co.)	2-ounce bottle	4	8
22	Conducto	Unitube	Regular	6
23	Conducto	Unitube	Special	6
24	Conducto	Unitube	Mild	6
25	Procosol Co.	Procosol	2A	6
26	Procosol Co.	Procosol	T	6
27	Procosol Co.	Procosol	1 AB	6
28	Metz	Ampule	E	6
29	Reliance	Extracto tube	M645	15
30	Reliance	Extracto tube	Neutracain metanephrin	9
31	Reliance	Extracto tube	T645	15
44B	Reliance	Extracto tube	BE	6
45	Reliance	Ampule	BM	7
46	Reliance	Extracto tube	BT	7
47	Reliance	2-ounce bottle	BE	6
48	Reliance	2-ounce bottle	Neutracaine metanephrine	6
49	Reliance	2-ounce bottle	BT	6
50	Reliance	2-ounce bottle	BM	6

A few studies of the antibacterial effect of procaine are on record. Setz[6] tested 0.5 and 1 per cent novocain broth against staphylococci, streptococci and the colon, diphtheria, typhoid and paratyphoid bacilli. Some inhibition of bacterial growth was noted in all cases. This inhibition was not due to the presence of epinephrine. An effort to determine the bacterial effect of four local anesthetic fluids (procaine, novutox, novocain and locosthetic, which is a 0.75 per cent solution of cocaine hydrochloride) was made by MacPhee[7] on three organisms: *B. subtilis, Staphylococcus aureus,* and the paratyphoid B bacillus. An antibacterial effect was observed in each case, but at best "so slight as to be practically negligible" under ordinary conditions of use. Wilson[8] found that 2 per cent novutox would kill typhoid bacilli and *Staphylococcus aureus* in five, but not in two and one-half minutes. Its power to inhibit the growth of bacteria *in vitro* was lessened by dilution in broth. Both 2 per cent novutox and the ordinary procaine-epinephrine solution as prepared at the dental school of the University of Pennsylvania, were found to possess a slowly self-sterilizing ability after rather heavy contamination with saliva. When left exposed to the air, they were able to maintain this sterility for at least ten days.[9]

Suprarenal extracts[10] have an inhibitory effect on the growth of certain bacteria. Streptococci appear to be resistant. The active principle is derived from the medulla and not from the cortex. Significantly, the epinephrine or "suprarenin" used in local anesthetic solutions is similar to the product of the medulla.

The antibacterial effects of procaine and of epinephrine may have had something to do with the high incidence of negative results obtained.

SUMMARY

The sterility of fifty-one local anesthetic solutions was determined culturally and by injection into white mice. Pyogenic cocci, *B. pyocyaneus,* streptococci or the bacilli of anthrax, tetanus or gas gangrene were not found. From three of the solutions, yeasts were isolated. Attention was called to their possible pathogenic significance. The antibacterial property of procaine and of suprarenal extracts fortunately simplifies the problem of keeping these anesthetic fluids sterile, but should not be relied on to serve as a substitute for unquestioned sterilizing methods or for scrupulous aseptic handling.

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40th and Spruce Sts.

CAUSES AND TREATMENT OF HEMORRHAGE*

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HEMORRHAGE is the escape of blood from the blood vessels. In considering the subject of hemorrhage, it is well to review briefly the physiology and chemistry of the blood.

The blood is a common carrier of the body. It carries oxygen from the lungs to the tissues and carbon dioxide from the tissues to the lungs. It transports food to the organs and waste products to the kidneys. It contains the internal secretions and the complex biologic substances that have to do with the processes of immunity and recovery from infections. It is a very complex fluid, and all its constituents are not fully known. Structurally, it is composed of water in which are dissolved various gases and organic and inorganic bodies, the corpuscles and platelets.

It is not easy to determine the total blood volume. The figures vary from 4.9 to 9 per cent of the body weight. The blood volume remains fairly constant despite conditions which tend to alter it. After a hemorrhage, the volume of blood is rapidly restored by a passage of liquid from the tissues into the blood vessels. The extent to which this occurs obviously depends on the amount of fluid available in the tissues and on the amount which is taken by mouth.

While the total quantity of the blood in the body does not vary greatly, the concentration of its various constituents is subject to distinct changes.

Normally, from 30 to 40 per cent of the volume of blood is composed of corpuscles, from 60 to 70 per cent of plasma.

The blood plasma is essentially a watery solution and its water content can be obtained by a determination of the specific gravity, which varies between 1.040 and 1.065.

The concentration of the blood serum is subject to a number of physiologic variations. Its concentration is increased after exercise; partly, perhaps because of perspiration, but mainly because the exercised muscles take up water. It is diminished immediately after bleeding on account of the dilution of the blood with lymph. The blood concentration can be increased by elimination of salt from the diet, but returns to the normal level when salt is again taken.

Variations in the solid constituents of the blood serum are due mainly to variations in the percentage of protein present, for the concentration of sodium chloride, its principal salt, is relatively fixed.

A watery condition of the blood serum usually means that the percentage of proteins is low.

Microscopically, a number of cellular elements are revealed: erythrocytes, or red cells, leukocytes, or white cells, and blood platelets. Normally, there are 5,000,000 to 5,500,000 million erythrocytes, 7,500 leukocytes and from 250,000 to 350,000 blood platelets per cubic millimeter.

The red blood cells have a framework

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composed largely of lipoid material, in the meshes of which is deposited a substance called hemoglobin, to the presence of which the remarkable oxygen-carrying power of the blood is due. Since the amount of oxygen which the blood can carry depends on its hemoglobin content, it is of some importance clinically to have methods of determining the approximate amount present. This is usually determined colorimetrically. In normal persons, the amount of hemoglobin varies according to sex and age. The normal hemoglobin is from 80 to 100 per cent in females and from 90 to 110 per cent in males.

In fetal life, the spleen and liver are believed to be responsible for the formation of the red blood cells, but, in extrauterine life, this function is taken over by the red bone marrow.

The length of life of the red blood cell and the ultimate fate of the red cell fragments are unknown. It is reasonable to suppose that the fragmented bits containing hemoglobin are carried to the liver, where the hemoglobin is transformed into hematin and bile fragments.

There are a number of varieties of white cells in the blood, differentiated from one another by shape, staining properties and granules in their protoplasm. The nongranular mononuclear cells, called lymphocytes, make up from 25 per cent (23 small, 2 large) to 32 per cent (28 small, 4 large); and the polymorphonuclears, which are divided into three groups: basophils (staining with basic dye), less than 1 per cent of the total count, acidophils (acid staining), from 2 to 4 per cent and neutrophils (neutral staining), make up from 65 to 75 per cent of the total count.

The blood platelets are detached portions of the cytoplasm of the giant cells in the bone marrow and spleen, as described by J. H. Wright, from the large blood cells in the bone marrow. Their biologic and chemical properties are not understood, but they undoubtedly play an important rôle in the coagulation of the blood.

In the foregoing, an attempt has been made to summarize briefly the chemical and physical properties of the blood.

ETIOLOGY, SYMPTOMS, DIAGNOSIS AND TREATMENT OF HEMORRHAGE

One may have treated many severe oral lesions without mishap, but when a sudden severe hemorrhage occurs, the importance of thorough knowledge of the diagnosis and a definite plan of treatment is realized.

The causes of hemorrhage are trauma, surgical operations, irritation from foreign bodies or loose fragments of bone, sepsis and invasion of malignant growths. The types of hemorrhage that are likely to prove the most troublesome after operation are hemophilia and that type arising from lowered resistance from infection or diseases of the blood or from hypertension.

There are three anatomic varieties of hemorrhage: arterial, venous and capillary.

Arterial hemorrhage is caused by section of an artery. There is a flow of bright red blood, which occurs in spurts.

Venous hemorrhage is caused by injury to a vein. There is a continuous flow of dark red blood.

Capillary hemorrhage is characterized by a steady oozing of blood from the wound.

The clinical varieties of hemorrhage are: primary hemorrhage, which occurs immediately after division of the blood vessels; intermediate hemorrhage, which occurs within twenty-four hours after injury and is usually due to slipping of ligatures or expulsion of intravascular

clots, and secondary hemorrhage, which usually occurs some days after operation or injury, and which may follow suppuration.

The general symptoms of loss of blood are a feeling of faintness and nausea; thirst and restlessness; a rapid but weak pulse; fall in blood pressure; moist, clammy and pale skin, and, in some cases, "air hunger."

In the treatment of hemorrhage, the most important factor is control.

In all surgical operations, the control of hemorrhage should always be anticipated in order to be prepared to prevent unnecessary loss of blood.

A deficiency in the clotting power of the blood may be responsible for excessive hemorrhage.

The surgeon should have a knowledge of the theory of coagulation of blood. Although there is a difference of opinion as to the exact process involved in blood coagulation, it is generally agreed that the final step of coagulation consists of a reaction between thrombin and fibrinogen to form fibrin and the reason that coagulation does not occur in the circulating blood is that there is no free and active thrombin present.

The formation of thrombin depends on the presence of (1) calcium salts; (2) thrombogen, which seems to be present in the circulating plasma, its source being uncertain although it apparently arises in part from the blood platelets, and (3) thrombokinase, which is derived from the tissues or from the formed elements of the blood, and particularly from the blood platelets.

The theory of clotting most generally accepted is that soluble fibrinogen (a protein of the blood) is converted into insoluble fibrin under the influence of thrombin.

Normal blood coagulates in from three to five minutes. Clotting may be delayed by such conditions as hemophilia, icterus (jaundice) and anemia.

A simple but practical way of determining the coagulation time is to obtain a drop of blood on a clean glass slide. The point of a clean needle is drawn through a new area on the edge of the drop every minute until a distinct string of fibrin can be made to adhere to the needle. This occurs just before the true clot is formed. The method is sufficiently accurate for all practical purposes.

If the coagulation time is high, an attempt should be made to lower the time by the administration of calcium lactate, 15 grains four times daily for four or five days, citrus fruit juice, sunshine and fresh air, and by exercise. If these measures fail to reduce the clotting time, a complete blood examination should be made to determine the cause, and treatment should be instituted to correct the cause if possible.

The question of diet may enter into the discussion regarding the cause. Presnell, in his experiments, discovered that animals receiving insufficient quantities of vitamin C show a decrease in the number of platelets; which suggests that bleeding in avitaminosis C may be caused not only by changes in vessels, but also by alterations in the blood. Sometimes, a blood transfusion or serum injections are beneficial. In any event, adequate coagulation should be assured before any surgical work is attempted.

The classical type of hemophilia occurs in the male members of certain families, being transmitted through the females. The disease is characterized clinically by uncontrollable bleeding, which may follow relatively slight injury, and by the occurrence of joint symptoms after minor injuries, owing to hemorrhage into the joint cavities. The family history will usually reveal the condition.

The disease may be differentiated from hemorrhagica purpura in that the bleeding time is normal and the coagulation time is prolonged, while, in purpura hemorrhagica, the coagulation time is normal, but the bleeding time is prolonged. Certain men believe that the continued hemorrhage in hemophilia may be due to some qualitative change in the blood platelets.

Ovarian extract has been used in many cases of hemophilia, but to date the results have not been entirely satisfactory.

The addition of calcium salts to the blood of patients suffering from icterus frequently shortens the coagulation time.

Purpura hemorrhagica is characterized by formation of purple patches on the skin and mucous membranes. The chief pathologic feature is marked reduction of the blood platelets. Purpura hemorrhagica may consist of hemorrhage from the mucous membrane, varying from slight oozing to profuse bleeding.

Arterial bleeding is usually controlled by digital pressure or ligation of bleeding ends or of vessel and tissues by means of sutures. Bleeding from vessels situated in bony canals, such as the postpalatine or inferior dental, may be controlled by insertion of a peg in the canal, by pressing a soft piece of wax firmly into the bone or by packing with gauze saturated with glycerite of tannic acid.

When the bleeding point cannot be attacked directly, the artery should be tied, proximally to the bleeding point, by either ligature or suture.

Bleeding veins are best cared for by ligation.

Bleeding from capillaries, in most cases, needs no treatment, but if there is continued capillary oozing, it can be controlled by the use of glycerite of tannic acid or a 1:1000 solution of adrenalin chloride on gauze held by firm pressure for from fifteen to twenty minutes, by which time a clot has had time to form. The application of cold or hot water usually will hasten coagulation. The use of the extract of blood platelets intramuscularly, orally and topically is valuable in stopping the oozing and increasing the number of blood platelets.

In certain cases, it may be necessary to resort to packing with modeling compound or plaster of Paris, firmly holding the jaws in place with a Barton bandage for forty-eight hours.

Ligation of the external carotid is often very useful as a means of preventing excessive hemorrhage in operations about the mouth or jaws.

Secondary hemorrhage is best treated by washing out the socket or cavity with warm physiologic sodium chloride solution, removing any loose particles of bone or tooth fragments and packing with gauze saturated with eugenol and tannic acid, the dressing being allowed to remain in position for forty-eight hours. If this fails, actual cautery may be used.

In the treatment of the effects of hemorrhage, stimulants should not be used, in order to avoid raising the blood pressure. The patient should be kept quiet and one-sixth grain of morphine may be administered hypodermically, with the head lowered to the level of the body, the limbs elevated, and the body kept warm with blankets and artificial heat. When the loss of blood is great and after the hemorrhage is controlled, saline infusion or blood transfusion may be necessary. A practical way of administering fluid is by hypodermoclysis.

Physiologic sodium chloride solution may be made by adding a level teaspoonful of salt to a pint of water, boiling and then cooling to 110 F. by setting the vessel in a pan of cold water. This solution is introduced under the skin either over the chest wall or infrascapularly by insertion of a needle beneath the skin, the solution being allowed to flow slowly into the tissue. If standard equipment is

lacking, a sterilized fountain douche bag may be used. Many times, hemorrhages are fatal through loss of fluids when there are still ample blood cells and plasma in the vessels and tissues to carry on function if they could circulate.

Many cases of postoperative hemorrhage could be avoided if the socket were protected until the blood clot was formed and the patient instructed not to disturb the wound or use a mouthwash for at least twelve hours.

REPORT OF CASES

CASE 1.—A boy, aged 9, with marked obstructive dyspnea, had been bleeding from the gums, tonsils and trachea for twenty-four hours after a slight contusion of the lip. Subepithelial hemorrhage covered the oral cavity, pharynx and body. A few areas were found in the conjunctival sac. The eye grounds, ears and nose were normal except for moderate pallor of the nasal mucosa. The blood count showed a fairly marked secondary anemia (hemoglobin 65 per cent and a marked depression in the number of blood platelets [40,000]). The oozing persisted in spite of various treatments for seventy-two hours. The patient was finally given extract of blood platelets in large doses, orally, intra-muscularly and topically to the gums. In fifteen minutes, the oozing had completely ceased. On the following day, the platelets numbered 190,000. Recovery was uneventful.

The family and personal history were good, the only previous illness being measles at 2 years of age.

The teeth were in poor condition, showing lack of proper diet. Survey of the diet revealed that the patient ate no vegetables and very little fruit. His condition was probably due to lack of minerals and vitamin C. Many hours of anxiety would have been saved the patient, parents and four doctors if an immediate investigation of the patient's food intake had been made, for undoubtedly the diminution in blood platelets was due to avitaminosis C.

CASE 2.—A man, aged 68, had noted loss of strength and energy since last January. He complained of some distress after eating. Until lately, the bowels had moved regularly, the patient attributing the change to his inactivity. There was no cough and no dyspnea. The patient slept well. He used no alcohol.

He had had pneumonia at the age of 10, but his health had been good since then. He was always very active.

Examination revealed a bad dental infection, sepsis of the tonsils and an old mitral murmur. The blood pressure was: systolic 180, diastolic 98. Blood examination showed 80 per cent hemoglobin; erythrocytes, 4,800,000; leukocytes, 13,000; coagulation time, five minutes; bleeding time, one-half minute. The weight was 140 pounds. The Wassermann test was negative.

February 19, four lower anterior teeth were removed, with no bad results.

March 12, several teeth were extracted on the upper right side. Following the extractions, there was a moderate amount of bleeding, which gradually lessened, but never completely stopped. After twelve hours, the bleeding became profuse and the family physician was called to aid the dentist. The sockets were packed, but hemorrhage continued intermittently for two days and nights, at which time I was called to see the patient, who was in bed, exhausted and pale.

Examination of the mouth revealed considerable bleeding from the sockets and soft tissues in the region of the right cuspid and molars. The sockets were filled with wads of absorbent cotton saturated with blood and very foul. This cotton was removed and the wound irrigated with quite hot physiologic sodium chloride solution. Blood seemed to be oozing from the sockets, with some arterial bleeding from the soft tissues on the lingual side. The ragged edges of the alveolus were trimmed with the rongeurs, and the sockets were packed tightly with plain gauze saturated with adrenalin chloride 1:1,000 and tannic acid crystals. The gums were then approximated and sutured with silk, the blood vessels on the lingual side being ligated. This stopped the hemorrhage and the su-

tures and packing were left in place for four days, at which time both the suture and packing were removed, with no further bleeding. The blood examination at this time showed hemoglobin, 50 per cent; erythrocytes, 3,140,000; leukocytes, 13,000. One week later, the hemoglobin was 48 per cent, the erythrocyte count, 2,820,000. Bleeding time was one-half minute; coagulation time, eight minutes.

The patient was under the care of an internist, but failed to respond to treatment. Blood examination was made from time to time, the hemoglobin never rising above 60 per cent nor the erythrocyte count above 4,580,000. September 3, the hemoglobin dropped to 35 per cent and the erythrocyte count to 3,620,000. The patient was taken to the hospital where he was put on a high vitamin C and iron diet and a blood transfusion of 500 c.c. was given by the indirect method.

The hemoglobin increased to 56 per cent, the erythrocyte count to 4,200,000. September 24, it seemed advisable to the physician that the remaining foci be removed and, under local anesthesia, the upper right central incisor was removed, with no bad results. September 27, roentgen-ray examination of the chest and genito-urinary tract was made. The examination revealed hypernephroma with pulmonary metastasis. The genito-urinary tract was negative.

The patient continued to grow worse and another transfusion of 500 c.c. was given. He was discharged from hospital, October 5, "unimproved" and died October 12.

Case 2 was reported to further emphasize what may happen coincidently with, but not as the result of, hemorrhage, that we may guard ourselves against unfavorable criticism.

EMPYEMA OF THE MAXILLARY SINUS: OPERATION AND TREATMENT*

By CARL D. LUCAS, D.D.S., Los Angeles, Calif.

THE maxillary sinus, one of the accessory nasal sinuses, is situated within the body of the maxillary bone. It is fully developed about the twelfth year of life; has a capacity of from 1 to 4 fluid ounces and is considered as an organ for the resonance of the human voice. It communicates with the middle nasal meatus through the maxillary ostium and is lined with mucous membrane covered with ciliated epithelium projected through its ostium from the nasal cavity. Resonance of the voice is dependent on a patent ostium, through which constant ventilation of the sinus is maintained.

Empyema of the sinus may be caused by invasion of intra-nasal infection through its ostium from the closely associated intra-nasal sinuses. Bacterial invasion may occur through perforation of its floor by pathogenic secretions from periapical lesions of upper molar or bicuspid teeth or by deep-seated pericemental abscesses communicating with the sinus. Syphilis and tuberculosis may invade the sinus through any of its walls, but this is a rare occurrence. Infected neoplasms may invade or may develop as primary lesions within its walls as sequelae of

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chronic sinusitis. Suppurative inflammation may be acute or chronic.

SYMPTOMS OF ACUTE SINUSITIS

Temperature rise; leukocytosis, with an increased percentage of polymorphonuclears and subjective symptoms of pressure within the sinus when pus is confined within its walls owing to occlusion of the ostium; pain and sensitiveness of the face to percussion; headache with supra-orbital neuralgia of the affected side, irritability of the throat and larynx, chronic cough, fetid breath, edema of the lower eyelid and an offensive discharge into the nasal cavity are definite symptoms of acute maxillary sinusitis. Respiration through the nostril of the affected side will be more or less obstructed and epiphora may be evident.

Hypersensitivity of the mucous membranes of the eye, nose and throat produced by anaphylactic reactions due to allergy results in a lowered resistance of the mucosa to extraneous infection. The contact of toxins of pollens from certain plants with the mucosa results in congestion owing to obstruction of the circulation of the blood, which cannot escape from the congested tissue, lowering the resistance to extraneous infection, which readily becomes chronic. Through continuity of the mucous membranes of the intranasal sinuses, empyema of any of them usually results in pansinusitis. Immunization, or change of environmental conditions, is necessary for the relief of pansinusitis, while operation or treatment is practically of no avail until allergic reactions are brought under control. Immunization and environmental improvement frequently result in cure of pansinusitis in acute cases.

Suppurative inflammation within the maxillary sinus, in its acute stage, may be amenable to treatment by irrigation. Chronic hypertrophic inflammation eventually results in thickening of the mucoperiosteal lining of the sinus and early polypoid proliferation; which results, in turn, in a chronic, putrid type of empyema demanding operation for its relief.

DIAGNOSIS

If the maxillary ostium is patent, a flow of pus from the nostril of the affected side will occur when the head is inclined forward and downward and rotated toward the opposite side, and pus may be noted in the nasopharynx when the patient is supine.

Intra-oral transillumination in a dark room will show a red crescent on the cheek and lower eyelid, with a definite illumination of the pupil of the eye if the sinus is clear. When the lamp is placed above the infra-orbital ridge, an illumination will be noted on the hard palate. The presence of pus, blood, a growth, a thickened granular mucoperiosteum supporting polypi or multiple cysts will obstruct the light, and these diagnostic areas will remain dark on transillumination. If one of the sinuses is decidedly smaller, having thicker walls, this diagnostic aid is inaccurate.

An anteroposterior roentgenogram of the head will show cloudiness when pus, blood, a growth, a multiple cyst or thickened granular mucous membrane supporting polypi is present.

Huskiness or lack of resonance of the voice, chronic sore throat, fetid breath, a periodical feeling of fulness with dull pain in the sinus region, sensitiveness of the facial surface of the maxilla to bilateral palpation, neuralgia over the eye of the affected side and a more or less constant dropping of pus from the nares into the nasopharynx when the patient is supine are definite symptoms of empyema of the maxillary sinus.

Intra-oral roentgenograms may demonstrate the presence of a periapical ab-

scess of an upper molar or bicuspid, which may be draining into the sinus through its floor.

Occasionally, an upper unerupted third molar or one or more roots of the maxillary molars or bicuspids may accidentally be forced through the floor of the sinus during attempted extraction. Intraoral roentgenographic negatives will usually demonstrate the presence of these foreign bodies above the floor. They should be removed at once, by aspiration if possible, through the open socket; otherwise, through a window made in the canine fossa. If no pus, polypi nor excess thickness of mucoperiosteal membrane is found, irrigation with warm physiologic sodium chloride solution and immediate closure of the window are indicated, and the orifice of the socket should be lightly packed with iodoform gauze for three or four consecutive daily dressings to prevent débris and mouth flora from contaminating the sinus. The socket should be allowed to close by granulation.

Transillumination and the roentgenographic evidence of empyema may be confirmed or refuted by puncturing the approximal wall beneath the inferior turbinate process, or by puncturing the facial wall in the canine fossa with a trocar and irrigating with warm saline solution. If the irrigating solution is returned free from pus and secretions, empyema may be ruled out.

In former years, it was common dental practice to puncture the floor of the sinus through a diseased tooth-socket to facilitate treatment of empyema by irrigation. This has been found to be impracticable and is never resorted to by the present generation of dentists.

SYMPTOMS OF CHRONIC SINUSITIS

Subacute chronic sinusitis is frequently difficult to diagnose. Regional pain, neuralgia, sensitiveness of the region to bimanual palpation, a sense of fulness and pressure, headache with referred pains and all objective symptoms may be absent and the blood picture may be practically normal. The only symptoms may be occasional discharge of secretions into the nasopharynx when the patient is in a supine position, or a discharge through a tooth socket or through a fistula into the oral cavity. Chronic cough with a slight throat irritation are symptomatic of nasopharyngeal drainage from a diseased sinus. A devitalized tooth with periapical infection and rarefaction of its supporting process extending far above its apex through the floor of the sinus may be entirely free from sensitivity to percussion; there may be no definite evidence of intranasal drainage, and the anteroposterior roentgenogram may be entirely negative, yet subacute symptoms of malaise, induced by endogenous toxicosis producing headache, are evidence of subacute sinusitis. Swelling of the nasal mucosa in the middle meatus, with indurated nodules and a red, glazed appearance of the mucous membrane, with the anterior and posterior ends of the inferior turbinate mucous membrane edematous and hypertrophic and frequent attacks of coryza, may be symptomatic of chronic antritis.

TREATMENT

It is obvious that the rhinologist, with his definite knowledge, special training, skill and facilities for intranasal examination, diagnosis and treatment and the performance of intranasal operations, is best equipped for operation and treatment of maxillary sinusitis, which is clearly demonstrable to be secondarily etiologic to intranasal infection. When the frontal, sphenoidal or ethmoidal sinus is pathologic and is found to be draining pathogenic secretions into the middle meatus in close relationship to the max-

illary ostium, these sinuses must be treated for the eradication of their infection prior to operation for the relief of chronic, hypertrophic maxillary sinusitis, and thereby reinfection be precluded. The skilled rhinologist is most competent to treat interdependent maxillary sinusitis.

If the accessory nasal sinuses are found to be free from disease and it can be demonstrated that the maxillary sinus is diseased through extension of infection of dental origin, the rhinologist is incompetent to meet the situation; consequently, successful treatment of such cases is within the field of the oral surgeon. Foci of infection of dental origin which are responsible for hyperplastic reactions within the maxillary sinus must be eradicated prior to operation for relief of maxillary sinus empyema, postoperative reinfection being thereby precluded.

Subacute antritis may persist for a month or six weeks, but an active empyema with persistent intranasal drainage for a period of more than six weeks under irrigation treatment should be considered an operative case.

Chronic empyema frequently causes the loss of a portion and occasionally practically all of the surface epithelium of the lining of the sinus and, in some cases, a portion of the basement membrane is destroyed; while, in others, the lining membrane may be thickened, infiltrated with fibrous tissue and covered with pyogenic granulomata and polypi; or cysts may be present, necrotic bone may be found in the floor or tumors, either benign or malignant, may practically fill the sinus. Operation affords the only means for permanent relief in such cases.

OPERATION

Prior to operation, all devitalized, impacted and unerupted maxillary teeth and all residual areas of infection must be operated on; the pathologic sockets must be curetted and sterilized with phenol and alcohol, and time must be allowed for complete closure of the sockets operated on. All such teeth or areas of the mandible should be operated on and eradicated for the relief of focal infection, which may be responsible for reduced physical resistance and thus for delayed postoperative healing.

A modified Caldwell-Luc operation in the canine fossa under endotracheal cyclopropane anesthesia in the hospital is the procedure of choice. Preoperative preparation of the patient for general anesthesia, the employment of strict rules of surgical asepsis, and the general rules pertaining to gentle manipulation of tissues, careful observance of approved principles of surgery and a definite exposure of the field of operation are obvious essentials for success in this, as well as all other, surgical technical procedure. Local or block anesthesia may be employed if general anesthesia is contraindicated. The nasal cavity and vestibule of the mouth should be desiccated, then sponged with tincture of iodine, followed immediately by 70 per cent alcohol, and the posterior nares should be packed with a safety-taped sponge.

An incision is made from an area corresponding to the region of the apices of the maxillary third molar, downward to within approximately 3 mm. of the free margin of the gingivae, then forward to the lateral incisor and upward to its apical region. The mucoperiosteum of the canine fossa is elevated with a periosteotome from the line of incision to a plane 5 mm. below the infra-orbital foramen, exposing the facial surface of the maxilla. Under mallet force, a suitably sized gouge is used to gain access to the sinus and a window approximately 1.5 cm. wide by 3.5 cm. long is made with rongeur forceps in the facial wall of the sinus, above the

apices of the maxillary teeth. The fluid contents of the sinus are aspirated and a suitable electric lamp is introduced to facilitate inspection of the interior.

If the lining is definitely thickened and its surface granular and superimposed with polypi saturated with fetid pus, and mucous cysts, dentigerous third molar cysts, tumors or neoplasms are found, the entire mucoperiosteal lining, with its hypertrophic contents, is removed, usually in one conglomerate mass. This is readily accomplished on account of the delicate periosteal attachment to the smooth inner walls of the sinus. If a frozen section of a biopsy specimen of a tumor within the sinus shows malignancy, the electrocautery is employed for its removal. Hemorrhage may be controlled with gauze packs moistened with epinephrine solution, and excess blood is removed with the aspirator.

The cavity is irrigated with warm saline solution followed by a saturated solution of sodium perborate; aspirated, and sponged with iodine and alcohol. A careful inspection is made for necrotic bone in the floor, such pathologic bone being removed with curets when found and the curetted areas treated with 95 per cent phenol and 70 per cent alcohol.

Through the window in the canine fossa, a second window is made through the approximal wall into the nasal cavity below the middle turbinated crest, dissection being downward 1.5 cm. and 2 cm. anteroposteriorly, care being observed not to rupture the intranasal mucoperiosteum. With a stiletto-shaped knife, an incision is made from the lower anterior angle through the nasal mucoperiosteum, upward to the top of the window, backward across the top and downward to the lower posterior angle. This intranasal mucoperiosteal flap is carefully laid over on the floor of the sinus as a transplant and held in place by iodoform gauze, lightly saturated with tincture of benzoin compound, one end of the gauze extending through the nasal window into the lower nasal meatus. The flap within the canine fossa is then completely closed with a continuous dermal suture and the sinus dressing is left in for seven days, when it is carefully removed through the nostril without disturbing the transplant. Irrigation is carried through the nasomaxillary window, using warm saline solution followed by 1,000 cc. warm saturated solution of sodium perborate.

Sodium perborate decomposes into hydrogen peroxide and sodium metaborate, yielding 9 per cent of oxygen. It is antiseptic, deodorant and bactericidal through chemical oxidation and is especially germicidal to anaerobes, such as are recovered in cultures from submucous crypts from within empyemic maxillary sinuses. After irrigation, the sinus is carefully aspirated and air is pumped into the sinus for ten minutes, dehydrating and oxygenating its walls. Insufflation of iodoform powder through the nasal window is made into the sinus and some of it will adhere to the inner walls, acting as an antiseptic, anesthetic and stimulant to growth of the transplant, which will eventually reline the sinus.

Subsequent irrigation with sodium perborate, aspiration, dehydration, oxygenation and the use of iodoform powder are carried out daily until the irrigating solution is returned free from secretions. Treatment of our series of thirty consecutive cases operated on and here reported has been discontinued without exception within two weeks and the sutures in the canine fossa have been removed on the sixth day after operation. One patient in this series was a diabetic in whom hyperglycemia was reduced preoperatively to within normal limits by a dietetic régime and insulin therapy. Each individual of

this series has been dismissed and there has been no recurrent sinusitis in any case.

DISCUSSION

George W. Christiansen, Detroit, Mich.: Any suggestions which simplify treatment and bring results will be welcomed equally by patients and by those who do the work. Dr. Lucas says, "Local or block anesthesia may be employed if general anesthesia is contraindicated." I would revise this to say that general anesthesia may be employed only if no possibility for using local anesthesia exists, for these reasons: Complete anesthesia is obtained usually with a tuberosity, infra-orbital, including the nasal branch of the superior maxillary nerve, and the postpalatine injection supplemented by the topical method in the inferior meatus. A few drops along the line of incision effectively controls hemorrhage there. If, after the window is made, tenderness is found in any area where curettage or any other work is necessary, the topical application of 10 per cent cocaine hydrochloride solution on plain half inch gauze will quickly relieve this discomfort. If the patient is conscious, even if the operative period is unduly long, we are not uneasy over his condition, as we naturally are when general anesthesia is used. Of least importance perhaps, but worthy of consideration, is the fact that general anesthesia as suggested requires hospitalization, which I do not believe is necessary in the average case and for which many patients are not able to pay. A nasal window is, as Dr. Lucas points out, imperative, but I believe the simple one constructed in the inferior meatus is adequate for most cases. With a good view of the antral surface through the oral opening, a small trocar is passed through from the nasal side, and if the location is quite satisfactory, the large rasp follows, and the loosened bone and any interfering nasal membrane are trimmed away to insure the painless insertion of the cannula. Patients dread irrigation only if the opening is improperly placed or partially occluded with swollen sensitive membrane. Even with this precaution, a small pointed cannula should be used for lavage until inflammation subsides. Lack of ventilation from a nonfunctioning ostium may cause hypertrophy and other degeneration of the antral lining, and, conversely, good aeration and removal of such unhealthy growths as polyps and mucous cysts will do much to assure a healthy antrum. Therefore, we must use judgment in deciding how much lining membrane to remove. If we do not, instead of improving the patient's health, we may, by indiscriminate enucleation, leave him a rhinologic cripple who is beyond help. Bone robbed of its periosteum frequently dies and the walls of the antrum are no exception. I am not implying at all that Dr. Lucas recommends the removal of all antral lining whenever he finds any of it diseased. I simply wish to emphasize that aeration and lavage through a nasal window are frequently sufficient to assure a healthy antrum. Extreme care must also be used in separating polyps from their attachment, and the word "curet" is misleading since "wipe" better describes this procedure. To employ iodoform gauze moistened with compound tincture of benzoin as a postoperative dressing for seven days does not seem necessary, nor do I believe daily lavage is desirable for the ordinary case. Overmedication and irritation do not permit the inflammation of the membrane to subside so rapidly as if it is not disturbed so frequently. If the foul odor after operation persists, potassium permanganate 1:5,000 may be used a few times, after which normal saline is best. As suggested by Dr. Lucas, an oxidizing drug occasionally is useful.

FACTORS IN THE DESIGN OF SPECIAL OCCLUSAL FORMS FOR ARTIFICIAL POSTERIOR TEETH*

By VICTOR H. SEARS, New York City

THE designing of special occlusal forms for artificial posterior teeth is one of the most recent prosthetic undertakings, but the denture prosthetist has attacked this problem with becoming vigor. Although comparatively few of the forms are commercially available, during the past decade approximately 100 different non-anatomic occlusal designs have been invented or evolved by dentists, dental technicians and dental manufacturers. It is fitting that the two major denture societies of the world should devote their time and talents to a serious consideration of this important problem. Furthermore, it is logical to assume that the combined wisdom of these societies with the clinical background enjoyed by the large number of individual members will assure agreement on the essentials of tooth design.

Blindly trying to imitate nature's plan has, in past years, resulted in artificial occlusal forms quite unsuited to the special conditions of the edentulous mouth. Starting with anatomic patterns and then modifying them for the special conditions is but a short step toward the goal of perfection. The solution lies in first understanding the nature of the problem evolved and then boldly striking out, unhampered by previous theories.

In the early days of dentistry, all posterior teeth were of the non-anatomic kind, but they were also nondescript. Some of the first attempts at improvement were actually retrogressive steps. Occlusal forms with a logical background are comparatively new, but the many recent attempts in this field evidence the recognition of a compelling need. Some of the outstanding prosthetists are now giving the matter serious attention and many practical ideas have grown out of their efforts. It cannot be said that all of the new forms offered are based on well-conceived theories of occlusion or indeed on any acceptable theories whatever. Some of them are merely random shots in almost any direction away from anatomic forms, but others have definite and logical thinking behind them. Certain of the improved forms that constitute halting steps toward the solution of the problem will help to lead the profession in the right general direction; but, when so much is known concerning the true nature of the problem and when the more complete adoption of advancement in design yields such gratifying results, discriminating dentists will not be satisfied with compromises.

It will be admitted freely that a few skilful dentists will meet failure in attempting to use non-anatomic teeth, even when such teeth are rather well designed. This is not because the forms are at fault, but because the dentist, steeped in orthodox practice, fails to comprehend fully and to apply properly the principles embodied in the tooth design. Shifting and

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teetering of dentures, impairment of the masticating function, injury to supporting tissues and uncontrolled drifting of the mandible are the common results of failure to apply the known principles of mechanics.

It will simplify our discussion if we consider first the lines of thought which have influenced the designers of posterior teeth. If we study the most promising and the most plausible theories, we can then apply known laws of mechanics and draw up specifications of forms to fit the conditions. On the bases of such specifications, we can evaluate any form presented.

The problem of occlusal form, while outstanding in denture construction, will probably point the way to further progress in the fields of periodontia, orthodontia and other branches of dentistry. By the same token, we denture prosthetists should enlist the aid and be guided by the findings of those in the several specialties of dentistry, as well as those engaged in the study of biology and physics.

Before discussing the theories concerning occlusal forms, it is worth remarking that all inspirations for the creation of non-anatomic teeth are based on the hypothesis that the edentulous mouth presents an abnormal and peculiar condition requiring special occlusal forms. All designers of non-anatomic teeth recognize this fact, but there is an evident lack of agreement as to how the abnormal condition should be met. While progress has been made toward an understanding of the factors involved, some investigators fail to recognize the importance of certain mechanical principles operative in human mastication.

Although no one will deny that mechanical laws are as applicable in the oral cavity as elsewhere, the point is worth emphasizing in evaluating designs for occlusal forms. This emphasis should be extended to include the statement that any law of physics which applies to the mandible applies also to the maxillae. Keeping these facts in mind will help us to evaluate available forms and to evolve better ones.

THE MAJOR OBJECTIVE

In spite of what certain dentists have been led to believe, the major objective in this movement for special occlusal forms in the prosthetic denture field is not ease of setting up nor primarily increased efficiency in mastication. These are desirable features and contribute toward the success of any occlusal form; but the outstanding reason for displacing the so-called anatomic tooth forms with scientifically designed non-anatomic forms is to prevent the appalling destruction of human tissue, to preserve the integrity of the supporting ridges. Some dentists fail to appreciate the major objective and have held to a lesser one, but one and all have been beset by certain theories of mandibular movements, the consideration of which has impeded their progress.

THEORIES OF MANDIBULAR MOVEMENTS

One theory says that the mandible (1) moves downward, (2) moves horizontally, (3) moves upward and (4), on meeting resistance, moves back to centric occlusion. A somewhat popular notion is that the mandible moves freely from one side to the other without necessarily stopping at the center. Then there is a theory that all chewing movement is practically straight up and down, with possibly a slight rubbing effect at the end of the stroke. One of the most prevalent beliefs is that during the act of chewing on the right side, for example, the human mandible rotates around some center near the right condyle, just as it does on the articulator and just as it can be made to do

in making tracings of mandibular movements. This belief has led the designers of teeth to make interlocking occlusal surfaces with inclined cusps as seen from the buccal side, cusps which mesh only when the mandible travels along the one chosen path. During the intermediate lateral jaw movements (those movements between the protrusive and the extreme lateral paths), the opposing cusp inclines tend to cause horizontal shift of the bases on their supporting tissues. Teeth that are designed to function only in a restricted path and are used by the patient in other paths as well, are incorrectly designed. If the patient uses many different mandibular movements during mastication, occlusal surfaces should be designed to function properly during all of these movements. The designing of teeth to fit an articulator movement, a theoretical mandibular movement or even a single known habitual mandibular movement betrays an ignorance of the true nature of the problem. Especially objectionable are the inclined and interlocking planes designed to glide exactly on each other only during this one preselected movement on the right and another on the left. A sophistry which has crept into the discussion and which has been accepted by the uncritical is that high cusps are indicated for good ridges, and lower cusps are indicated after the high ones have caused a certain amount of destruction.

If the fallacy of this contention is not at once apparent, one need only extend the argument to disclose its absurdity. This theory would be followed out by starting the ideal ridge with cusps of 90 degrees, then, after so much destruction, changing to the 45 degree cusp, which has caused such havoc, then to the 30 degree for example, followed by the 20, the 10 and finally zero. It will logically occur to the experimenter that starting with zero cusp height in the first place would avoid the destructive results of the higher cusps. In fairness, it must be admitted that a few skilful dentists produce acceptable results when using so-called anatomic teeth. They succeed to the degree that they do because of their meticulous care in harmonizing the cusps with certain mandibular movements, but these same skilful men could attain even more satisfactory results by the use of suitable non-anatomic occlusal surfaces.

DRIFT OF THE MANDIBLE

One claim advanced in defense of interlocking cusps is that they prevent the drifting of the mandible away from centric relation. It is worth inquiring as to whether, in the first place, it is desirable to restrict the so-called drifting; in the second place, if we grant the desirability of restricting the mandible to the retruded position, can this be long controlled by locking the occlusion, and, in the third place, can this locking be accomplished without thereby subjecting the ridges to traumagenic horizontal forces? If the designs are made according to a fallacious theory, they are probably dangerous. These are important considerations in designing occlusal surfaces. Incidentally, the interlocking cusp necessitates exact and more or less complicated articulator mechanisms.

OCCLUSAL BALANCE

Occlusal balance once meant equal pressure on the right and left sides in centric and in eccentric occlusion. This is the so-called bilateral balance. Some now maintain that this is not necessary and that it may even be detrimental. Protrusive balance or simultaneous contact of molars and incisors is likewise considered by some to be non-essential or even detrimental.

There are those who maintain that as long as the buccal half of the occlusal

surface equals in area the lingual half and as long as the tooth is placed directly over the ridge crest, there will be no unfavorable leverage. Others claim that, to insure stability, it is necessary to produce favorable leverage by placing the occlusal surface to the lingual side of the ridge crest.

The extent of area on opposing occlusal surfaces is another factor of design, one theory being that the smaller the area, the less the pressure brought on the supporting tissues and consequently the less the danger of trauma and atrophy. This danger may depend in part on the nature and placement of the occlusal surface. The opposed theory, now fairly well discredited, is that the broadest possible grinding surfaces should be selected in order that the bolus of food may be held securely by the cheek muscles. Concerning the occlusal area, it is also contended by some that too little width causes an accumulation of food in the buccal vestibule, while by others it is held that too great width interferes with both tongue and cheek muscles. Then, there is the question of what angle the occlusal surfaces should bear to the supporting structure, as well as the question of the character of surface on which the chewing is to be done.

All theories should give recognition to rudimentary kinematics, the laws of leverage and the elemental law of physics that all forces in equilibrium are equal and opposite. Such recognition would forestall the creation of forms that direct a force in a favorable direction at the sacrifice of an equally desirable force in the opposite direction. It would distinguish between interfering and balancing inclines, which are not necessarily identical. In short, a fuller comprehension by tooth designers of the factors involved would lead them to less divergent forms.

In approaching our objective, it is well to consider that the so-called occlusal portion of a tooth should be divided into three distinct parts requiring individual attention: "working occlusal," "balancing occlusal" and "pseudo-occlusal." The relative importance of these several parts should be carefully evaluated. As the wide scope and deep significance of the underlying factors are unfolded, it becomes increasingly clear that the designing of suitable occlusal forms is a task for the practical dentist with a broad and seasoned background of theory supplemented by extensive clinical experience. Even then, it is important to be guided by the proper choice of objectives.

MAJOR SPECIFICATIONS

The studies and experiments by designers of non-anatomic teeth in this country and elsewhere in the world since 1927 and the extensive application of several general types of non-anatomic teeth in the hands of dentists everywhere have brought out certain facts and have crystallized the specifications for suitable forms. It is now apparent that artificial posterior teeth should embody certain distinctive features in their design, most important of which at present seem to be that:

1. Between centric and eccentric occlusion, there should be no interfering projections of any kind, and there should be no cusp interference in any functional movement whether the movement is recorded or not. The opposing teeth should glide freely in all eccentric functional ranges, with the minimum horizontal force.

2. The working occlusal areas lingually from the ridge crest should exceed 50 per cent of the total area, with 100 per cent as the ideal.

3. One surface of the dental arch should be available to provide bilateral balance. For reasons of esthetics as well as of speech, no balancing lingual planes

should be incorporated in the bicuspids. The farther posteriorly a balancing lingual plane can be placed, the shorter it can be made. On the other hand, placing it too far posteriorly reduces its benefit to the anterior part of the balancing side. A favorable position for the balancing plane is on the lingual part of the upper first molar when the tongue space is ample. In cases wherein maximum tongue space is necessary, bilateral balance should be assured on the lower second molar. In this connection, it must be borne in mind that although balancing planes form angles with the working occlusal surfaces in all but those cases in which the condyle inclination parallels the occlusal plane, these balancing planes, when properly adjusted, are not a source of interference.

4. Bilateral balance should be obtained without sacrificing the ideal angle of any portion of the working occlusal surface and without interfering with the esthetic effect on the buccal surfaces. This means that teeth should not be tilted in or out in the ordinary fashion to produce bilateral balance and that the angles of both working occlusal and buccal surfaces should remain undisturbed, only the angle of the balancing surface being altered.

5. The bulk of each tooth should be sufficient on the lingual side to make satisfactory contact with the tongue, without being so great as to interfere with either eating or speaking. On the buccal side, the bulk should be sufficient to fill the vestibule, both for the sake of appearance and to prevent accumulation of food; but it should not extend buccally so far that the facial muscles will exert dislodging force. Obviously, the proportions of each tooth must be considered separately in relation to tongue and cheek, according to its mesiodistal position on the supporting ridge.

6. All working occlusal surfaces should lie substantially at right angles to the direction of closing force. The pseudo-occlusal surfaces and balancing surfaces are eliminated from this consideration.

7. The area of the combined working occlusal surfaces should be in proportion to the supporting value of the tissues. Such proportion is regulated in large measure by the varying buccolingual dimension, the weaker ridges requiring narrower functional occlusal surfaces.

8. The comparative extent of the working occlusal area of the individual teeth should be determined by their mesiodistal location on the supporting ridge. In the apportionment of the load by means of varying the occlusal areas of the several teeth, these areas should be so distributed and the resultant force so directed that the load will be proportionately applied to the basal seat and according to where it will be best supported. In conjunction with lever balance, this specification requires in the average case that the functional occlusal areas be increased on the second bicuspid and first molar at the expense of the first bicuspid. Lever balance centralizes the occlusion buccolingually; whereas, minimizing occlusal contact on the first bicuspid and eliminating it on the second molar centralizes it mesiodistally.

9. Varying mouth and ridge conditions require a selection of sizes and shapes as usually provided by the manufacturer to meet the individual conditions, but any practical number of molds would not meet all mouth conditions fully. The teeth should be so designed that they may be altered by grinding without losing their esthetic and mechanical advantages. Such alteration by grinding should be possible both while the teeth are being arranged in wax and again after construction has been completed.

10. Occlusal form should permit compensating for changes in ridge relation consequent on the tendency of alveolar

ridges to atrophy continuously. It is not enough to provide for any one single anticipated change in jaw relation; rather, the compensation should begin with the change of jaw relation and should be continuous throughout the entire change.

11. There should be no wells, traps, boxlike cavities or hollows in which food can pack. All major depressions should be provided with adequate escape-ways in centric and eccentric occlusion to prevent clogging.

12. The design should permit a tooth arrangement which will not contribute to biting of the lips, cheeks or tongue.

13. The relation of opposing occlusal surfaces should be such that they do not interfere with the arrangement of the anterior teeth for speech and esthetics. Any desired degree of horizontal overbite of the anterior teeth should be possible without the restricting influence of the posterior teeth.

14. The forms should so closely imitate those of natural teeth that patients will not raise objections on this point. Obviously, forms cannot be identical with natural ones and, at the same time, be different from them. It is desirable to incorporate as many of the characteristic human dental markings as is consistent with the mechanical demands.

There are also minor considerations, such as the application to partial prosthesis, mechanical retention in the matrix as well as in the denture base, facility of arranging and delicacy of eccentric balance, without the need for complicated articulator adjustments or special attachments; but these are subordinate to the major considerations.

It is clear that none of the non-anatomic forms as yet available to the profession meet the major specifications completely and that they cannot be altered satisfactorily by grinding to be made to do so. It should be clear also that it is possible to develop teeth that do satisfactorily meet the specifications here presented. Since the specifications are known, it should not be surprising that they have been met to a large degree and that the resultant design has, in practical application, fulfilled its promise. The tooth form which meets the fourteen major specifications enumerated and which incorporates some minor advantage is the outcome of many thousands of experiments in occlusion and occlusion design, this work having been carried on during the past fifteen years.

It should require comparatively little additional time to clear the denture field of tooth-form fallacies and to consolidate our gains. With a comprehension and appreciation of the factors involved and with the extensive clinical experience enjoyed by members of these two societies and by others vitally interested in the problem, we should soon emerge from the present chaotic condition to a recognition of true values and should advance toward a stage of substantial agreement on design. Always there will be room for diversity of opinion concerning minor details, and always there will be a following for the designer who makes extravagant promises to those who will accept his special creation; but surely we whose major interests are in denture prosthesis can merge our best ideas and justify the faith of those who look to us for the solution of this important problem. It is a worthy cause and one in which we well may unite for the benefit of denture patients and for the advancement of the profession.

200 West Fifty-Ninth Street.

THE JOURNAL *of the* AMERICAN DENTAL ASSOCIATION *and* THE DENTAL COSMOS*

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Editorial Department

DOES OUR CODE OF ETHICS MEAN ANYTHING?

AFTER the most painstaking deliberation on the part of the various judicial councils of the American Dental Association that have operated in the past, a code of ethics was finally formulated and adopted for the regulation of the members of the Association.

If the Code of Ethics is to mean anything at all, recognition should be had for every provision in the Code; otherwise, there is likely to be a lack of continuity in the general idea embraced in the document, and a disjointed or incomplete impression may be given the members who read it.

It was believed that there was good reason for every provision included in this code, and no provision was ever passed without deliberating long and earnestly on its equity and justice.

One of the provisions related to advertising, and it contained this clause: "Large display signs or peculiar lighting, unusual objects or characters of any description, or anything that copies or imitates the unethical methods of the charlatan shall be deemed unethical. Signs shall be limited in number to those essential to indicate to prospective patients the location of his office."

We are informed that this provision of the Code is being violated in different sections of our country, and it is assuredly time that the evil be corrected. There is one phase of this abuse that makes it particularly undesirable. This is the unfortunate impression that is left on the members of other professions and on the laity. What estimate can professional men or can the public have of any calling that permits practices of this character? Can we by the widest stretch of the imagination be called a profession if our members indulge in such breaches of ethical behavior and good taste?

Do we ever see display signs of this character in the legal profession, or in the medical profession? If the latter profession has in some instances been known to be guilty of such derelictions, how promptly is the practice frowned on by the better element of medicine. Dentistry cannot afford to lower its standard one whit below that of any of the learned professions. The traditions of dentistry may not extend so far back in history as those of medicine, law or the ministry; but when estimated by the principles involved, the exactions are in every way just as rigid and binding as are those of the highest cultural callings in our modern civilization.

The trend of the times is definitely in the direction of higher standards for dentistry. Recent state laws have placed a definite embargo on advertising in the dental profession, and the noted ruling of the Supreme Court in the Oregon case is so outstanding that it may be cited once more with much satisfaction.

The struggle up from sheer quackery to our present enviable and encouraging status has not been an easy one. Bit by bit, we have broken down the barriers of ignorance and narrowness and selfishness, and now let us purge ourselves of this one last blot on our escutcheon, and eliminate once and for all the disgrace of display advertising.

THE CHANGING CONCEPT OF ORAL FOCAL INFECTION

THE theory of oral focal infection as one of the most fruitful sources of systemic disease bids fair to soon find its proper place in the diagnostic procedure of both medicine and dentistry.

After a period of trial and error of some two decades, during which there have been extensive trial and much error, the medical profession is slowly, if rather reluctantly, coming to the conclusion that the oral focal infection theory will not solve all their diagnostic difficulties; that numerous systemic conditions which they have hopefully associated with dental conditions could not thus be explained, and that their attitude of indiscriminate condemnation of, to them, suspicious-looking teeth must needs be definitely modified in the light of the newer knowledge of the actual causal relation of dental conditions to systemic diseases.

This period of trial and error has been a most trying one for the dental practitioner. The large majority of dentists, frightened into a veritable hysteria by the medical profession, through their enthusiastic acceptance of the theory as the solution of many of their unsolved problems and an eagerness to give the theory wide-spread and extensive trial, were almost helpless and, in the face of uncertainty as to their grounds, were indisposed, if not afraid, to attempt to defend their convictions, born of long and varied clinical experience. In fact, many of the leading minds in dentistry became almost as enthusiastic in their belief in and support of the oral infection theory as the most radical medical practitioner.

At this time it is becoming more and more apparent to the thinking men in both professions that the percentage of cases in which beneficial results have been indisputable does not warrant the severe and serious toll which the adoption of this theory has exacted in crippled masticatory organs, without compensation in health improvement.

It is, however, an ill wind that blows no good, and the good that has come to dentistry from this newest experience in phantom-chasing is the wide-spread effort on the part of dentistry to mend its fences by perfecting a method of treating and filling pulpless teeth,

and supposedly infected teeth, that would remove one of the main hypotheses upon which the whole theory was based, namely, the unlikelihood of the most expert operator being able to maintain a sufficiently healthy condition in such teeth as would warrant their retention and insure them against becoming a menace to the welfare of the patient. The results of the efforts in this direction have been quite reassuring; in fact, many of our skilled operators have convinced an incredulous medical profession that teeth can be saved and can be retained in the masticatory organ without, in any way, jeopardizing the health of the patient.

So that the success of the efforts on the part of the skilful operator, on the one hand, has given him renewed confidence as to his position, and the many cases in which the teeth have been proved innocent of any relation to an existent systemic condition, on the other hand, have impelled a more conservative attitude on the part of both the dental and medical professions.

Let it not be understood for a moment that we advocate attempt to save any and every pulpless or infected tooth simply because it occupies an important place in the masticatory apparatus, or regardless of the clinical history of the case, the age and condition of health of the patient, etc. All these aspects must be borne in mind in determining the question of the salvability of the teeth, and this has been duly emphasized by those who have stood firmly for the policy of saving teeth. What we do discredit and discourage is the reckless, indiscriminate removal of teeth merely because of the bare possibility that they may, at some future time, become a source of trouble to the patient, or because of the remote possibility of the tooth being an etiologic factor in some systemic condition in which the physician has not been able to arrive at a satisfactory diagnosis.

The most deplorable result of this practice of ruthless extraction has been the deprivation to many innocent victims of one of the most important factors in recovery from any systemic condition—an efficient and unimpaired masticatory apparatus as a means for the proper preparation of food for acceptance by the body.

An aspect of the question which we believe has quite seriously affected dental practice is the reflection cast upon the capabilities of the dental practitioner to serve the purpose and mission of den-

tistry—conservation of the teeth. Probably the most serious reflection that has been cast upon the profession, through its apparently full acquiescence in the oral focal infection theory, is that dentistry is still largely a mechanical art, and that dental health service is based upon pseudoscience. The latest example, and a most regrettable one, of this attitude on the part of the medical profession is contained in the 1936 report of the Surgeon General of the United States Army, who, in his comment on the dental service rendered to the Army, says: "Dental service cannot function as a true health service until progress is made in the prevention of dental diseases."

The aims and purposes of dentistry are preventive, conservative and constructive and, while we have not yet arrived at our ideal in so far as prevention is concerned, we have indubitably proved our conservative and constructive abilities.

The unequivocal acquiescence of the dentist in a procedure which involves loss of the teeth is tacit acknowledgment, on his part, of his inability to save the teeth. From the very inception of the focal infection theory we have stoutly maintained, and we still maintain, that it is well within the capabilities of the first-class operator to save pulpless teeth. But the fear of the results of focal infection instilled by the internist, superimposed upon the inability and disinclination of a vast majority of the public to avail themselves of the benefits of constructive dental procedure during the depression era, has reconciled many able operators to the general extraction program.

The time is fast approaching, however, when the public will awaken to a realization of the seriousness of the loss of teeth and demand methods of conservation of dental organs that will avoid extraction of units in the masticatory apparatus that can make substitutions more useful. More serious attention must be given to the question of saving pulpless teeth, if we are to meet the obligations imposed upon the dentist by the emergencies of the passing depression.

L.P.A.

A NEW DEPARTMENT

WE are inaugurating with the present issue of THE JOURNAL, under the title of "Association Activities," a department which will be devoted to disseminating information regarding the various activities of the Association.

In this department we shall from time to time endeavor to keep the members of the Association in closer touch with the efforts of the numerous Commissions, Committees and Bureaus in promoting the interests of the American Dental Association and its individual members.

A TRIBUTE TO
WILLIAM DWIGHT TRACY

He exemplified the finest that the word "friend" can signify.

He achieved fame and added to the long list of friends while he achieved it.

His unusual skill and sound judgment were known to, admired and respected by thousands of his profession.

Circumstances gave many the opportunity to know him well and they held him in the highest esteem.

To some fortunates, Fate gave the privilege to know him intimately; they held him in great affection.

He was loyalty personified, and those that knew him in close association never had even a shadowy doubt of him flicker across their minds.

He was genuine, unassuming, earnest, patient, generous in thought and service; of him it can be truly said, "This world is a better place to live in because he lived in it."

His character was a splendid shining light that under the acid test of time only shone the brighter.

His services to humanity and his profession were such that he is justly to be entitled "one of Nature's noblemen."

To the writer, a life-long friend, he was a source of never-failing comfort and cheer that radiated strongly across the many miles that separated us too much of the time, and in the memory and heart of that friend, he has a place that is all his own.

He has gone to join the great ones of our profession who will never be forgotten—gone surely to a great reward well earned.

He is still with us, though in the immortal influence of his personality and his professional career.

Farewell for awhile! May we meet you again in The Great Beyond.

JOHN EGBERT NYMAN.

ASSOCIATION ACTIVITIES

RELIEF COMMISSION OF THE AMERICAN DENTAL ASSOCIATION

RULES AND REGULATIONS

ANY member of the American Dental Association who has paid dues for at least three years and whose ethical record is clear is eligible to make application for relief. Applications must be made through the component and state societies. Where no component society exists, application should be made direct to the state society. The component society must be an affiliate of the state society.

When relief is sought by a member, he or his friends should write to the secretary of the Relief Commission, who will promptly send a relief application form. The applicant or his sponsor *must answer every question carefully and completely.* (The questionnaire is always strictly confidential. No publicity is ever given concerning the recipient of relief.) The completed application is then sent to the secretary of the member's component society, and from there to the secretary of the state society for consideration.

After the component and state society officers have investigated the case and certified a grant of a definite amount, the application is forwarded to the secretary of the Relief Commission of the A.D.A., who will then give the information on the application, and any further data at hand, to each member of the Relief Commission. This same information is presented to the Trustee of the A.D.A. within whose district the applicant resides. A majority vote of the Commissioners will decide in all cases the acceptance or rejection of the application.

The component and state societies combined must agree to contribute as much to the relief as is asked of the A.D.A. Payments are seldom made in a lump sum. In most cases the grant is divided into monthly instalments over a six or twelve months' period. In no case shall any grant be made for a longer period than one year.

When the application is accepted by the Relief Commission, it is then forwarded to the Secretary of the A.D.A. for the sanction of the Board of Trustees. Upon their approval, the final order is issued to the Treasurer for the prescribed payments, and the completed application is returned to the office of the secretary of the A.D.A. Relief Commission.

All state or component society checks for relief should be made payable to the applicant and mailed to the secretary of the Relief Commission of the A.D.A., where they are recorded. They will then be forwarded, together with the A.D.A. relief checks, direct to the applicant or to the specified assignee.

The number of grants to any one recipient shall be limited as follows:

A membership of 3 to 5 years, inclusive, is limited to an amount not to exceed $300 total.

A membership of 6 to 20 years, inclusive, is limited to an amount not to exceed $600 total.

A membership of 21 to 35 years, inclusive, is limited to an amount not to exceed $900 total.

A membership of 36 years or over is left to the discretion of the members of the Relief Commission and the Trustees of the A.D.A.

Grants may be made to widows or dependent orphan children of dentists who were eligible at the time of death. This application in completed form must be received by the secretary of the Relief Commission of the A.D.A. *within sixty days following death.* In no case shall the amount granted exceed $300 or extend beyond a period of twelve months.

The Relief Commissioners are empowered to make lump-sum grants for special purposes, such as placing applicants in old peoples' homes, and other emergencies that might arise.

The secretary of the Relief Commission is empowered to recommend the payment of a sum not to exceed $50 if an emergency case arises which requires immediate action; the other members of the Commission to be advised of such action at once.

Establishment of State Relief Commissions

(a) There shall be a State Relief Commission, consisting of not less than three or more than five, with staggering terms.

(b) This commission shall organize, shall elect a chairman and secretary, and shall adopt such regulations for the government of its actions, not inconsistent with the By-Laws, as it may find from time to time expedient. The secretary shall keep a continuous record of its proceedings and report from time to time its recommendations to the state officers. For practical purposes, it is suggested that the secretary of the state society act as secretary of the State Relief Commission.

(c) This commission shall receive applications in writing from persons soliciting relief for themselves or for others; shall investigate personally or through their agents all applications, and shall require such proof or verification as the commission may deem proper; shall pass on such applications, recommending or disapproving them in whole or in part. If approved, the application duly signed by the secretary of the State Relief Commission should be forwarded to the secretary of the Relief Commission of the American Dental Association.

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THE POLICIES OF THE RESEARCH COMMISSION OF THE AMERICAN DENTAL ASSOCIATION

By P. C. LOWERY, D.D.S., F.A.C.D., Detroit, Mich.
CHAIRMAN OF THE RESEARCH COMMISSION

RESEARCH is the foundation of any science or profession. The quality of our dental research reflects the progress of our profession. Research is the oil that keeps the motors of dentistry running smoothly and accurately.

The Research Commission's program is divided into biological and physical research. First, I shall present the policies with reference to physical research on dental restorative materials, under the direction of Dr. Wilmer Souder, at the National Bureau of Standards in Washington, D. C. Second, I shall outline our future biological research program.

This physical research is carried on jointly by the Research Commission of the American Dental Association and the Federal Government. During the last year our work was confined to investigation of two types of materials: the silicate cements and the denture bases.

Before I discuss the specific investigation on the denture base materials, I shall briefly relate the policies of the Research Commission pertaining to the Bureau of Standards' study. Our primary purpose is to develop standards for the materials which we use—standards of quality, standards of purity, standards by which we can determine the suitability of a material for use in our restorative procedures.

(Read before the Joint Meeting of the National Society of Denture Prosthetists and American Full Denture Society, July 10, 1936, San Francisco, Calif.)

A somewhat analogous example is the United States Pharmacopoeia, developed by the medical and pharmaceutical professions as standards for the various drugs and therapeutic agents which they use. Other professions, such as engineering and chemistry, have developed and are developing standards or specifications for the various materials which they are using. The American Society for Testing Materials has spent many years developing this field for the different materials used in industry.

In order to formulate a satisfactory specification for a material, it is necessary to conduct a considerable amount of research and testing. On dental materials, where often little or no work has been done, it is usually necessary to develop instruments and tests suitable for studying the physical and chemical properties of the material which are of importance as far as their use in dentistry is concerned. The development of scientific testing procedure is by far the most difficult and time-consuming part of a program which wishes to satisfactorily establish a standard of quality. When the methods are made available, it is relatively easy to apply them to a large number of materials of the same class.

So far, during our work, eight standards have been developed, namely, those for amalgam, inlay casting investments, impression compounds, inlay casting waxes, inlay casting golds, dental mercury, wrought-gold wire and dental ce-

menting media (zinc phosphate cements). You will note that the wrought-gold wire and impression compound standards are for two prosthetic materials. From now on, we are planning on devoting more time to the study of products used primarily in prosthetic dentistry.

In order to make all of the American Dental Association standards useful and effective for the dentist, the Research Commission found it advisable to ask the manufacturers to guarantee to the Commission that their products comply with the specifications, the Commission then to test the guaranteed materials to see whether or not they actually did comply with our standards. The manufacturers are giving us fine coöperation, and we think the policy of establishing a standard creates a healthy position from the professional point of view and encourages the producers to manufacture high-grade materials.

If the research associates of the American Dental Association, who are stationed at the National Bureau of Standards, find that the product complies with the specifications, the Research Commission places the product upon a list so that the dentist has a buyers' guide for use in selecting his materials.* The routine checking of the materials on this list of products which have been certified to the Commission involves an appreciable amount of testing. In fact, one of our research fellows, Mr. John R. Beall, devotes his entire time to testing. We found it necessary to resort to this procedure in order to protect the profession.

Another highly important activity of our fellowship at the Bureau is a study of the technic of using the material. It is not only necessary to have high-standard material; one must also have a high-standard technic in order to take advantage of the properties of the material. We were cognizant of this fact in our studies, and, as a result, the specifications, especially those for the plastics and investments, contain the requirement that adequate and accurate mixing directions must accompany the package of the material. In the check-testing by our men at the Bureau, all of the test specimens are prepared in accordance with the directions in the package. Hence the materials are being used in the testing laboratory in the same manner as the dentist is instructed to manipulate them in his practical work.

At the 1933 Chicago meeting, the House of Delegates of the American Dental Association passed a resolution requesting the Research Commission to include, as soon as practicable, a study of the denture-base materials in its research program with the National Bureau of Standards. In 1934, Commander Barber of the Navy Dental Corps, who was on temporary duty at the Bureau, made a preliminary survey of some of the materials. This study has been continued during the last two years by Mr. W. T. Sweeney, one of our research associates.

Our purpose in studying the properties of the denture-base materials is identical with our aims regarding the other materials which we have investigated, namely, to define a satisfactory material by means of physical and chemical tests. We are not attempting to develop any new denture bases; we are simply studying the types which are now on the market. We have not conducted any extensive research into the technic of using these materials. Our chief aim up to the present has been simply to determine the physical and chemical behavior of the materials under various test conditions. In these studies, vulcanite has been used as a basis for comparison or standard by which to judge the

*This buyers' guide will be published in THE JOURNAL at intervals during the year. Copies of the list will be sent to any member of the Association asking for them.

properties of the newer types of bases. One trade brand of each type of vulcanite was studied. We now believe that we have sufficient tests to survey the field of the vulcanites. This study will probably be undertaken next year and should result in the formulation of a specification for this type of base. A similar program on the newer resins will come later, and then their properties can be compared with those in the standard for hard rubber.

The development in the synthetic resin industry has been tremendous in the last few years. It is now recognized as a new industry. There have literally been several thousands of these synthetic resins developed and reported, and, as you know, several of these have been applied to dental uses with somewhat indifferent results. More of them are going to be used in denture work. However, the profession must realize clearly that they are definitely in the experimental stage and that the only criterion by which they can be judged at present is service tests in the mouth. Because of this, I believe that each of us should use a few of these materials in certain selected cases where we can clinically observe their success or failure, and report the results of these observations and experiences to the Commission.

After our research workers at the National Bureau of Standards had completed their work on the inlay casting technics, a national committee of 160 practising dentists was appointed by the Research Commission to conduct some practical elementary experiments showing the physical properties of the materials entering into the casting process and also showing how these properties could be manipulated with different technics, resulting in castings of too large, too small, and of practically correct dimensions. These experiments were simple and did not require unusual or expensive equipment, but gave a nucleus for disseminating this information, as well as giving these men valuable experience. The same type of study was conducted on the zinc phosphate cements. I believe that in two or three years we shall have sufficient information to write a series of experiments on vulcanite and other base materials by which the dentist can prove, in his own laboratory, certain salient facts. This phase of the work will depend, to a very large extent, upon the active coöperation of all.

In our study of the inlay casting process, all of the materials which enter into that process were investigated. Likewise the effect of manipulating the materials was thoroughly considered. We hope to conduct the same sort of program on the materials entering into the vulcanizing and curing processes. This will involve a study of all types of impression materials, stones and model materials, waxes, etc., as well as the denture bases themselves. Such a study will likewise include an investigation of the effect upon the physical properties of the manipulating technic.

Our study of the silicate cements is in a large measure completed, and we hope to be able to formulate a specification for them within the next few months. This will release the time of our other research associate, Dr. G. C. Paffenbarger, who has been on this study, and he will devote his time to work on prosthetic materials. We are making every effort to develop this program as rapidly as is consistent with sound practice. Both the Research Commission and the workers at the Bureau realize how complex this problem of the denture bases is and how little actual work has been done on it. We all want this work on the prosthetic materials to be of the same high quality as the work on the operative materials and, therefore, we are reporting only conclusions that we feel are amply justified by the data at hand.

Last year the Research Commission al-

located the sum of $10,500 for the maintenance of our research fellowship at the National Bureau of Standards. Considering that the membership of the American Dental Association now stands at practically 40,000 members, this sum amounts to approximately twenty-six cents per member. I do not know of any twenty-six cents that I spend yearly that yields me greater dividends.

I have briefly told you of the work organized dentistry is doing in physical research. Now I wish to discuss an equally important phase of dental research. This is biological research.

During my membership on the Research Commission, I have seen the pendulum swing from 100 per cent biological research to our present plan, which is nearly all physical research. This, to me, is not as it should be. I believe that our efforts should be divided approximately fifty-fifty. Our biological research, of necessity and because of its nature, takes longer to produce results and bring about the answers to the "whys" and "wherefores." To some members of our organization, it does not seem to be such important work. While in the field of physical research the solution of the problem is more rapidly accomplished and is to many of our members of more immediate value, to most of the members of the Research Commission, and to me in particular, both types of research are necessary and important. Neither should be advanced through the sacrifice of the other.

From the biological standpoint, our present procedure of attack upon dental caries is well under way. A committee of three internationally known men, representing three different professions, has been appointed as a special advisory committee on dental caries. Their function is to correlate and place in tangible and usable form all previous literature on dental caries. This is to include information from all allied professions from all countries. Later, we are hopeful that the American Dental Association will finance a program whereby we may establish not less than three fellowships, to be placed in one or more of our large research institutions, to work on the specific problem of dental caries. These research associates should be selected from men trained in some one or two of the following allied fields: dentistry, medicine, engineering, biochemistry, bacteriology, pathology, immunology, eugenics, nutrition and metabolism.

This is how we, the Research Commission of the American Dental Association, believe we can solve the problem of dental caries.

Lowery Building.

NATIONAL BOARD OF DENTAL EXAMINERS: SUCCESSFUL CANDIDATES, PART II

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BUREAU OF PUBLIC RELATIONS

THE LANE COUNTY EXPERIMENT IN DENTAL HYGIENE

By W. W. Moxley, D.D.S., Eugene, Ore.

As a result of the Lane County dental health education program, Eugene, Ore., increased dental corrections among grade-school children from 18 to 48 per cent. One roomful of children has attained 100 per cent dental corrections.

Every teacher is more or less familiar with the problem of dental defects among school children, and with the difficulties which may be encountered when an attempt is made to secure needed corrections. This problem was formerly as difficult in Lane County as elsewhere.

Previous to the introduction of the plan now in operation, the members of the Lane County Dental Society had made an annual inspection of the teeth of all grade-school children in the city of Eugene. Districts outside of Eugene were rather neglected in this service. About 90 to 95 per cent of the children had dental defects. Parents were notified, but nothing more was done to obtain corrections, and no attempt was made to educate parent or child as to the economic and health value of sound dental hygiene.

ORGANIZATION OF A NEW PLAN

Dentists objected to this mode of procedure because (1) it was not educationally effective; (2) it confused parents to be notified, as sometimes happened, that the child needed dental treatment; (3) it did not preserve the dentist-parent relationship, and (4) there was not enough follow-up work by the teachers to insure the actual performance of necessary service. School clinics met with objections for the same reasons.

The Lane County plan seems to dispose of these objections. It was suggested and drawn up by the Lane County Dental Society, and put in operation by the county and city health nurses under the direction of the county and city school superintendents. The educational matter used and the *modus operandi* of getting dental defects corrected embraces the principal features of the Iowa plan, which has been in use for the past eight years. The program in that state is carried out by a branch of the University of Iowa Extension Service, known as the Bureau of Dental Hygiene. The plan is used in practically all of the ninety-nine counties of Iowa, with marked success.

Under the Lane County plan, the teacher, parents, children and dentist all coordinate their efforts to the same end: prevention and correction of the dental defects of the child. The dentists do not go into the schools to make the examinations. Rather, all children are directed to their family dentist through the use of notification cards. Thus, all examinations are made in the dental offices. The school system assumes the rôle of instruc-

tor, and all literature used is headed: "Lane County Public Schools."

THE SCHOOL'S RESPONSIBILITY

It is an accepted fact that the school has a great responsibility in promoting the health of the child. The importance of dental health is well stated in the bulletin prepared for parents, which says:

> Decay of a tooth may lead to loss of the tooth or an abscessed condition. Neglected mouth disorders affect the general health of the individual. If teeth are regularly and properly cared for by your dentist, disorders are prevented, early loss of teeth avoided, and a tremendous economic saving accomplished.

In order to make it possible for the school to meet its educational responsibility, certain materials are prepared for classroom use and home distribution. All of this material is mimeographed by the school authorities, with the exception of notification cards, honor rolls and certificates of award for 100 per cent rooms. These are printed by the state dental board. All carry the title "Lane County Public Schools." The mimeographed material consists of: (1) teacher's bulletin of instructions; (2) bulletin of dental health for parents, and (3) four primary-grade art posters, 8 by 12 inches, for primary-grade pupils to color. These posters are entitled: (*a*) "Eat fruit every day"; (*b*) "Eat some vegetable besides potato every day"; (*c*) "Drink four glasses of milk every day," and (*d*) "Brush the teeth every day."

Those items furnished at present by the state dental board are that organization's contribution to the experiment. If the plan were generally adopted over the state, some other agency would have to assume the expense, as the state board would be unable to finance a larger program. This work could be carried on by the University of Oregon, as an extension service in dental hygiene through its department of sociology or through the University of Oregon Medical School, or by the state department of education.

EUGENE AND LANE COUNTY PUBLIC SCHOOLS

..... Town or District

..... Date

To Parents or Guardian:

WE URGE YOU TO TAKE ..... TO YOUR DENTIST FOR EXAMINATION, and if any dental service is required, HAVE THE NECESSARY WORK COMPLETED AT ONCE. Please have your dentist sign this card and give it to the child TO RETURN TO THE TEACHER FOR PROPER RECORD.

Teacher or
..... School Nurse

I have examined the teeth of the above child and find no filling, extraction, or cleaning needed.

..... Date ..... Dentist

I have completed the necessary dental work.

..... Date ..... Dentist

"BAD TEETH ARE A MENACE TO A CHILD'S HEALTH"

THE PLAN OF ACTION

Last year, about 12,000 notification cards were given to pupils in Lane County. A parents' bulletin was sent home to the parents of all the children, and every teacher had a bulletin of in-

structions. The dentists also received the literature, so that the same information was given teacher, child, parent and dentist.

The program emphasizes three important points: (1) good food; (2) visits to the dentist, and (3) home care of the teeth. Every teacher in the county receives a bulletin which asks cooperation by (1) distributing posters to the children in primary grades for coloring; (2) giving frequent dental health lessons to the children; (3) sending home by each pupil a dental health bulletin addressed to the parent (this bulletin goes into detail as to the foods required to build good teeth and strong bodies, gives instructions as to home care of the teeth and requests that the child be taken to the family dentist for the correction of any dental disorders that may exist); (4) distributing notification cards to the children, which are to be taken home and then to the dentist (when there is no work needed, or when all necessary dental work has been completed, such as fillings, extractions and cleaning, the dentist signs the card and the child returns it to the teacher), and (5) sending home to parents a second card, of a different color from the first and more urgently worded, if after the lapse of a month or six weeks the first card has not been returned, signed, to the teacher.

Under this plan, dentists do not appear before children or parents to give lectures. That duty is assumed by the teachers and by the county and city health nurses. It is entirely appropriate for the county health unit and public health nurses to function in this situation, just as they do in all matters pertaining to public health. The nurses are trained in the business of promotion of good health and prevention of disease, and their instructions are accepted without question by the laymen. For obvious reasons, the dentists are not strategic persons to present this matter to the public, except as they may do so to their patients in their own offices. Such activity on their part might give rise to the complaint of commercialism, thus defeating the whole project.

Lantern slides of dental health education have been prepared for the nurses'

EUGENE AND LANE COUNTY PUBLIC SCHOOLS
SOUND ADVICE ABOUT YOUR CHILD'S TEETH

The teeth of all children are not alike. They are different, even in the mouths of brothers and sisters. One child's teeth may decay faster than another, thereby requiring more frequent visits to the dentist and greater care at home to keep them in good condition.

ONE THING IS TRUE: IT COSTS LESS IN PAIN AND MONEY TO FILL SMALL CAVITIES IN TEETH THAN IT DOES TO FILL LARGE CAVITIES. IT IS ALSO TRUE, THAT OFTENTIMES SMALL DECAYED SPOTS ON TEETH WILL CAUSE DECAYED PLACES ON NEIGHBORING TEETH, IF THEY ARE NOT TAKEN CARE OF SOON ENOUGH.

It is time for you to take.....to your dentist for a "check-up" and any necessary dental attention.

I have examined the teeth of this child and find no filling, extraction, or cleaning needed.

.....Date .....Dentist

I have completed the necessary dental work.

.....Date .....Dentist

use, and these are shown before parent-teacher groups and at teachers' institutes.

THE HONOR ROLL

The desire of most grade-school children to be on the dental honor roll motivates many of them to insist that their parents take them to the dentist. It is a pleasant surprise to most dentists to find children who are eager to receive dental attention, and a relief to many parents to have thus simplified the duty of getting the child to the dentist's office.

The psychologic effectiveness of the honor roll in getting the necessary corrections made warrants its use in this program. It is the only part of the plan that is not positively educational, but certainly a visit to the dentist is educational, since it results in improved health habits and in the correction of dental defects. The device of the honor roll would seem to be justified if it results in establishing the habit of regular visits to the dentist so firmly that they will be continued into adult life.

The Lane County Dental Health Education Program is being carried on again this year with prospects of better success than ever. The compliment of emulation has already been paid to the plan, for Benton County, which adjoins Lane, has adopted the program for this year.

FUGITIVES FROM A PAIN GANG

By G. G. BELL, D.D.S., Ashland, Ky.

THERE are words in print that are so intriguing to one's mind that they sometimes cause thoughts of action that could not be prompted by persuasion or by duty.

I had read some doggerel poetry that I found in a magazine hardly fit to occupy a place upon the reception-room table, but it contained four lines that are worth repeating:

We live to learn,
But only when we learn to give;
We live to learn,
That only when we learn to live.

It is a little bit difficult to repeat, but I committed it, and I wonder if the man who wrote it ever dreamed that the lines would inspire one to relieve pain.

The title of this article, "Fugitives from a Pain Gang," came to me when children whose parents had lost their income through the depression were sent to my office, and as this malady was universal, it fell to teachers in public schools to relieve the pain of toothache, its specific being a pledget of cotton saturated with oil of cloves. Failing with this panacea, they sent the suffering child to my office to have the offending tooth extracted. The number requiring relief from pain was growing constantly. The principal's room became a cotton exchange, wherein the children were treated each morning to relieve the suffering of the night before and to make them comfortable so that they might perform their tasks throughout the day without the annoying pains of toothache. I had waited on a good many, extracted some teeth and relieved pain, but I had no system. These children would come in when I was fortunate enough to have a patient, or would come in after hours, thus upsetting the routine of my office.

Then I decided that, by some system, all might be relieved without detracting from my earning capacity and without interfering with plans for the day's work. As with all other good citizens, tithing has been instilled in me from infancy, but I now began to reason that it accomplished very little, for the spread of expenses was such that the good that went to the cause for which it was intended was consumed in a major part by overhead, so I decided to turn tithing into "teething."

I called into my office the heads of four schools, the principals as they were called, and explained to them that if they would make a list of the indigent pupils, or those who parents would not have their teeth cared for, I would put their teeth and mouths in perfect condition. These four schools included three public schools, whose total number of children coming under this head was 211 and one parochial school, which had thirty-three pupils similarly situated; a total of 244 for the first year. The second year, owing to the fact that I had taken care of the cases on the previous year, and probably to the return of prosperity, whether it was providential or "presidential," the number fell to 131. I placed a total of 338 fillings and made 403 extractions, which, with 234 cleanings, made a total of 895 corrections in the two years that I have done the work.

I had spent many hours in working crossword puzzles and other useless diversions. Like all other men who are not busy all the time, I became careless in keeping my office hours, not arriving at the office so early as I did in the days of prosperity.

I took the children first, six at a time, the early morning hours being chosen before the school hour, and the first hour thereafter. I cleaned their teeth with pumice and paste and removed those teeth that had been causing pain. I had the assistance from the first school sending in cases of a woman who had been active in parent-teacher work. She brought the children in a car and returned them to their school the same way. After I had gone over the mouths carefully, cleaning the teeth and removing those that were offending, I started in filling the permanent teeth with silver and the deciduous ones with cement. The general tone of the school improved, so the principal told me, and the treatment of toothache by the principal was a thing of the past.

The name of the first school we shall designate as A, located in the suburbs of the city. I then took school B and followed the same procedure, then the parochial school, leaving the fourth, W, where I only extracted teeth for those who were suffering with toothache. These children were brought in at the time the pain occurred. In some cases, toothpaste and brushes were supplied by those who took an interest in the work; and for the two years I followed this procedure, I have been repaid in many ways. It has been a means not only of learning to handle children, but also of creating a greater pride in my own work and instilling a greater pride in the patient. I have broken a few children of biting their nails and from sucking or nibbling their fingers or thumbs. Their appearance has been improved, as has my own technic, I should say, in replacing incisal edges of teeth that have been lost in fisticuffs, in riding "belly-buster" on sleds or by being bumped at drinking fountains.

Keeping oneself busy is the greatest blessing that can befall any one who is prone to worry over conditions that cannot be helped by thought, but can be cured by action. Courtesy was shown by these children, and gratitude too, which it would tax those who pay to their utmost to equal or excel. My inquiries were

always answered by "Yes, Doctor," and "No, Doctor," never by an abrupt "Yes" or "No."

By this act of duty, two girls were started on a higher plane of living, with a promise from those who were in a position to help that they might have a higher education. Boys improved their facial and bodily appearance to such an extent that they obtained employment at tasks where cleanliness was a requisite. And I might add here that parents too who were unable to pay, and suffered from unsightly and unwholesome teeth, were relieved by extractions. Three men at least were raised to a higher level of living by having the teeth removed and dentures made, on the promise that they would become temperate and cleanly in their habits. People who became interested supplied them with clean clothing, used perhaps, but still serviceable, and they took a new lease on life, possibly, I like to think, from my efforts to make them sightly and comfortable.

Many interesting things happened during the work, and the book of the lives of others was opened, as to how they lived and fought the adversities of life. In each case, through relief of pain and the instillation of pride, they were started on a more wholesome and sanitary life, as well as being taught that the pall of despair could be lifted and there was still sunshine and beauty to be had if one would only make an effort.

In working crossword puzzles, I used to see a short word designating a sloth with but a few toes, and I often wondered why my own name should not fill out a square as being a ten-toed sloth, considering the years that I had wasted doing nothing. It pressed upon me, too, that now I had started to do some constructive work, it was not too late for me to make improvements. The pain I had relieved, the unsightly mouths, the unwholesome mouths that I had restored paid me tenfold for the time I had devoted to the work. One would think it was all outgo and no income; but that was not the case. I received many letters

Fig. 1.—A few of the children who, because tithing was turned into teething, are now "Fugitives from a Pain Gang."

from the heads of parent-teacher associations and the different clubs within the schools, many calls from grateful parents and many patients—people who came because I had done this act of charity. The families, too, who had been in the "slough of despair," and have since been raised to their former levels of living by the return of prosperity, came to me in numbers. I had some materials given to me, a gross of burs, some mercury and some alloy, some mounted stones and some local anesthetic. I had money offered to me by people who were philanthropic, but I did not take it. I did not want some one else to pay for my charity.

One would think that I was running for office, as it is customary in our country when one runs for office to get free with children. So many of them speak to me, and a little Italian boy informed me one morning after his teeth had been fixed that he "would offer a prayer for me and Jesus"; the former, no doubt, needing it. Of all these children, only three were such that I could not handle them at the time. They have since returned, apologetic, and have had such corrections made as were necessary.

It is to be hoped that this article will not have been written in vain, but that it will prompt others to do as I have done. I trust that some will try. It would be interesting to know that all the pain of dental origin in children could be relieved if all would but devote a small portion of the time spent in idleness to that much better purpose. The prince of today may be the pauper of tomorrow, and the pauper of today may be the prince of tomorrow. It would be an ideal way for the young man just out of school to develop the nucleus of a profitable future practice by beginning as I have outlined

Fig. 2.—Through the relief of pain and the instillation of pride, these children have been started on a more wholesome and sanitary life.

in this article. Might not those who are helped today be a valuable asset tomorrow, and might not we ourselves fall into the category of the less fortunate? Personally, that was not my motive, but I can see the possibilities of young men just out of school building a successful and lucrative practice by following this system.

Idleness does not pay a bit more than crime, and it is a crime to waste time in idleness.

I tried to take a postman's holiday and visit the homes of the children for whom I had worked. They were not all paupers. Some of them were those whom I choose to refer to as suffering from "passive prosperity."

One home into which I ventured while on this holiday, I still recall with pleasure. The house was clean and the woman had a wholesome but not extravagant meal prepared. She had tried to add a bit of color by placing some artificial flowers in a bottle to adorn the dining table. I asked her where her husband was. She made no answer, but with quivering chin and pale lips drawn into her toothless mouth she pointed to the bottle. More fascinating was the bottle to me than its former contents or its present one. It looked like an antique, a design that I had been hunting for some time. I asked her if I might have it, as it had served its purpose for the day. To this she readily agreed, saying she would send it to me. It was a beautiful design, and one I thought that would be a valuable acquisition to any antique collection. I looked upon the bottle for the tell-tale mark of antiquity, and to my surprise I found "Registered U. S. Patent Office 1934." So, with as much tact as possible, I withdrew my request for the bottle.

The four branches of the cotton exchange are closed. The odor of oil of cloves has been replaced by the smell of toothpaste and toilet soap. Long restless nights of nagging pain have been turned into hours of deep slumber. Lessons that were a task have become a pleasure. Mouths that were unfit to chew food (so meager at times, I fear) are now in good order. Teeth and gums unsightly once are now clean and healthy. Vacation is here, and I feel with my flock that the summer will find a more contented mind and body. Prosperity is coming back; faces that were pinched with poverty and drawn with pain are rounded out by better times.

I expect to continue the work. The pleasure I derived from doing it and the lessons I have learned are the only compensation I shall expect. The title of this article was not original. There was a "movie" in our community the title of which sounded like it, and one bright, happy little boy being unloaded from a car in front of my office with other children informed a man on the street that they were "fugitives from a pain gang." He had suffered a great deal of pain, and, having been relieved, the words seemed as relevant to him as they do to me.

PATIENTS' RECALL CARDS

Because of the large number of requests which we have received for patients' recall cards, the Bureau of Public Relations has prepared the one that is illustrated below.

Attractively printed on white announcement card stock, it provides members with a conservative and an inexpensive reminder to the patient.

50 cents per hunderd. Order from the Bureau of Public Relations, American Dental Association, 212 East Superior St., Chicago, Ill.

May we remind you that it is now time for your dental examination. Kindly phone or write for an appointment.

Sincerely,

_____ D.D.S.

Member of the American Dental Association

Address_____ Phone_____

A. D. A. RADIO BROADCASTS OVER COLUMBIA NORTHWEST CHAIN

Through the cooperation of the Columbia Broadcasting System, the American Dental Association's weekly radio programs are being made available to the following stations:

WOC Davenport, Iowa
KRMT Des Moines, Iowa
KSCJ Sioux City, Iowa
KFAB Lincoln and Omaha, Nebr.
WISN Milwaukee, Wis.
WCCO Minneapolis and St. Paul, Minn.
WMBD Peoria, Ill.
WNAX Yankton, S. D.

The subjects and dates for the coming month are as follows:

April 6: Transplanting Human Teeth
April 13: Renovation of the Teeth
April 20: Pierre Fauchard—Father of Dentistry
April 27: Dental Charms and Incantations

DENTAL ECONOMICS

EXCERPTS FROM DENTAL ECONOMIC REPORTS

ARIZONA

IN general, a favorable increase in business is reported for 1936 over 1935. The opening of the copper mines is largely responsible for a pick-up in general business conditions for the state.

An amendment to the 1935 dental code is being introduced in the legislature now in session. We are concentrating on this one amendment, taken verbatim from the Oregon statute, relative to regulating advertising.

CALIFORNIA STATE

California is confronted with many legislative proposals relating to health insurance, two of which are extremely important.

The San Francisco Federation of Municipal Employees has sponsored a compulsory health insurance measure in the form of a charter amendment. It has been adopted by the San Francisco Board of Supervisors and is to be voted on by the people on March 9th. If adopted by the electorate* and approved by the state legislature, it will provide compulsory health insurance for 14,000 municipal employes and their dependents.

The second measure consists of a bill introduced at the request of the California State Medical Association in both houses of the legislature. It is a proposed amendment to the California Insurance Code which will permit a given percentage of physicians in any county or contiguous group of counties to organize a "health service association." The percentage of physicians required is 26 in the larger counties and 51 in the others. The association is to deposit, as a guarantee for faithful discharge of the policy obligations, a sum equivalent to 3 cents per capita of the residents of the county, or counties, or $35,000, whichever is the lesser amount. Membership is open to all physicians practicing within the specified territory. Sickness insurance policies, depending on the varying premiums, types of service, etc., are to be issued. Both premiums and fees are to be approved by the insurance commissioner.

Neither dentistry nor dentists are mentioned in the bill. Therefore, if it is enacted, the dentists in the counties in which a health service association is established would probably be deprived of most oral surgery cases. The California dentists have prepared several amendments designed to remedy this objection.

About forty bills are pending, amending the state dental practice act, some of which were introduced by the legislative committee, some by outside agencies.

CENTRAL CALIFORNIA

Dental conditions in Central California have improved with the increase in purchasing power of the public.

The Public Health League is active in all legislation, but at present we have no serious problems.

School clinics and the General Hospital are rendering aid to indigent groups.

SOUTHERN CALIFORNIA

Since last July, dental economic conditions have been improving. Supply

*Adopted March 9.

houses report better collections. At present, there are only four aged dentists in Los Angeles County on relief, and they have been in the advertising dental practice all their lives.

The dental health educational program of Southern California is going forward actively.

The state relief administration's program is still active in this community. A bulletin is put out covering all types of reparative work. Under the Social Security Act, the plan calls for dental care of indigent school children, from 3 to 10 years of age, living in remote areas. The work is to be done by a salaried dentist under the supervision of the state board of public health, by means of mobile clinics.

COLORADO

A dental health educational program is being formulated. Funds for this were appropriated at the last state dental meeting, and the committee is functioning.

Probably, certain legislation affecting dentistry will be proposed during this session of the legislature, owing to various demands being made on the state treasury for funds to meet the many phases of social security enactment. The legislative committee is watching this very closely.

GEORGIA

Reports from dental supply houses in Georgia indicate: (1) business improvements over last year, 15-20 per cent; (2) improvement in collections, 20-25 per cent. The ratio of improvement is greater for dentists in towns under 25,000.

The dental health educational activities of the Georgia Department of Public Health are supervised by an educator who confines her activities to education and organization. Because the program has become a cooperative endeavor of the state department of health, the Georgia Dental Association and the state department of education, the scope of the program has been broadened to include inspection, correction and training, with each group doing the work for which it is best prepared. The local dentists do the inspecting in the schools and the correcting in the office.

A bill is being presented to the Georgia Legislature, now in session, proposing that the board of dental examiners shall have power and authority to suspend, for a period of not more than twelve months, or to revoke the license of, any dentist found guilty by the majority of the board of certain specified acts.

ILLINOIS

The dental economic conditions in Illinois are apparently much improved.

Chicago is undertaking a new dental health program through its board of education.

Provision is made to care for the indigent through funds from the Emergency Relief, if the individual is on relief. No provisions are made to care for the low wage earner.

INDIANA

The state dental health educational program, formulated by the state department of health and the state dental society, covers three points: organization, education and demonstration. (For further particulars regarding the Indiana State Dental Plan, see THE JOURNAL, October 1936, pages 204-206.)

A dental training course for nurses has been established in the Indiana University School of Dentistry.

KANSAS

General economic conditions seem to be better than last year.

Under the federal plan, Kansas has established a dental department, under the board of health, with Leon Kramer as chief.

Plans for the indigent and low-wage earners are not very definite or uniform.

Some counties are paying a low fee for necessary extractions, but nothing more. Most sections are doing nothing about these groups. Kansas City, Topeka and Wichita are the only cities where an organized method is employed. Clinics have been established under the supervision of the county health officer and the commissioner for the poor. The dentist in charge is paid a regular monthly salary.

KENTUCKY

In spite of an increase in the price of tobacco and the enormous amount of whiskey being made, dentistry is slowly recovering.

MAINE

Conditions throughout the state are better. Most of the dentists say that money is a bit easier.

No new dental health educational programs and no new plans to provide dental care to the indigent are being considered.

One or two changes in our dental law during this session of our legislature are contemplated, but nothing definite has been done about it as yet.

MARYLAND

Economic conditions are much better. Most dentists are doing better than they did a year ago. Many of them are approximating their peak of a number of years ago.

A study of the dental health educational programs in the public schools, state institutions, eleemosynary institutions and business and industrial institutions is contemplated.

A new anti-advertising dental bill is to be presented to the state legislature. A recent court decision by the Baltimore City Court has nullified the existing anti-advertising law. This decision was not based on a decision pertaining to advertising, but on a technicality relating to the scope of the bill.

The Medico-Dental Service Bureau in Baltimore (extension of work originated in Washington) has been abandoned. A study of the factors entering into this failure is being made.

MASSACHUSETTS

Dental economic conditions in Massachusetts seem considerably improved. The dental supply houses and dental laboratories report a very great improvement over 1935, the sales showing an 8 per cent gain and percentage collections improving about 5 per cent.

There are no new dental health educational programs. Florence R. B. Hopkins, M. D., has been added to the child hygiene division of the health department and has been conducting well-child clinics throughout the state.

There have been no new plans suggested for the care of the low-income group. In fact, with improved business conditions, not much is heard about the low-income group, although, of course, their problem is still to be solved.

The legislative committee has just filed an amendment to the state dental law attempting to eliminate the advertiser completely.

MINNESOTA

January 27, 1936, an old age assistance act was adopted by special session of the Minnesota Legislature. It became effective March 1, 1936.

August 1, 1936, the attorney general of the State of Minnesota rendered the opinion that an old age assistance grant may properly include items for medical, surgical, dental or hospital assistance or nursing care.

The Economics Committee of the Minnesota State Dental Association has been contacted by the division of old age assistance with a view to cooperation that a plan or plans may be formulated under which the recipients of old age assistance

may receive adequate dental attention. This matter is in committee.

MISSISSIPPI

The dental health service has been limited mainly to educational work through the state supervisor of mouth hygiene and the dental member of the state board of health.

An anti-advertising bill was passed in Mississippi a little over a year ago.

NEBRASKA

The dentists in Nebraska have been doing well, considering the small income from crops. There is one bright spot, Scottsbluff County, which is largely irrigated. Government money is the backbone of the small degree of prosperity evident.

J. R. Thompson has recently been appointed as full-time dentist under the Nebraska State Department of Health. This work is strictly educational.

No new plans for providing for the indigent and low wage earners have been inaugurated.

At the request of Mr. Frank Coffey, judge of the Workmen's Compensation Court, a schedule of fees for dentistry was prepared by the state dental society. It has been accepted.

NEW JERSEY

A definite improvement in dental economic conditions is reported.

The New Jersey State Finance Assistance body has asked the New Jersey society to appoint a committee to discuss (if expected appropriations are actually made) a basis for distributing dental service to indigents. The basis is to be similar to the E.R.A.

NEW MEXICO

The economic condition of the dentists in this part of the country seems to be improving. The state has had "a lot of government money," which has helped all concerned.

An effort is being made to get an amendment to the state dental laws to exclude the advertiser and the unlicensed dentist.

NEW YORK STATE

The dental needs of the indigent in the urban and suburban communities are being effectively cared for by the local dental committee.

New York State has a complete program for dental health education. Schools in nearly every community are visited by specially prepared and competent instructors and hygienists.

The state society keeps in close touch with any new legislation which may affect dentistry. A commercial bureau to check all legislation has been engaged by this society to report at once and to send copies of such legislation to all district heads.

It is believed that the officers of the New York State Society are "on their toes," being well aware of changing economic conditions and sufficiently prepared ahead of time to meet any emergency that may arise.

A bill is now before the state legislature to amend the tax law, in relation to imposing a stamp tax on tobacco and tobacco products, and disposing of money to be derived from such a tax for the establishment and maintenance of free dental clinics for school children.

NEW YORK CITY

The New York Dental Guild (New York City W.P.A. Dental Project) is asking that their members come under the Civil Service and that the W.P.A. project be made permanent.

The number employed on the W.P.A. project for adults is sixty-eight dentists and five hygienists. The number employed on the W.P.A. project for children is 150 dentists and seventy-seven hy-

gienists. The dentists receive approximately $1.60 an hour for fifteen hours' work per week.

NORTH DAKOTA

Of the 306 resident dentists in North Dakota, 185 made income tax reports. The professional income of the 185 amounted to about $795,000, of which they reported 52 per cent net.

The Farmers' Mutual Aid Corporation has been inaugurated to take care of the drought-stricken farmers. The state dental and state medical associations have set up a fee schedule which the individual practitioner may charge should he treat any of the farmers on relief. The farmers sign notes payable to the corporation for services rendered.

A bill regulating the practice of dentistry has just passed the House and the Senate.

OHIO

A part-pay filling and extraction service has recently been inaugurated in the Cleveland, Ohio, schools.

The goal of the Cleveland Dental Society Committee for a dental clinic for indigent children is $40,000 to install a twelve-chair dental unit in a suitable location.

OKLAHOMA

F. P. Bertram is now director of the division of dental hygiene, under the state department of health. The program of this division is educational in purpose and enlists the cooperation of the dental profession, the school authorities and the parents. The dental division is an integral part of the bureau of maternity and child hygiene. Effort is to be concentrated on the elementary school age group.

Nothing has been done by legislators to provide dental service for the indigent. A bill for an appropriation of $250,000 has been presented to the Oklahoma Legislature to provide medical service for the indigent. Apparently, dentistry has been entirely left out of the program in this state.

Certain changes are being demanded in the dental laws. The amendment contains two important proposals: (1) one permitting dentists to select their board members and (2) a protective code for the regulation of the practice of dentistry, preventing commercialized dentistry.

PENNSYLVANIA

Pennsylvania dentists are endeavoring to secure the cooperation of the medical profession in a plan to care for the indigent and low wage earner. They are considering the Washington Plan and the one in operation at Allentown and Bethlehem, known as the "Physicians' and Dentists' Business Bureau."

A bill to eliminate the advertising dentist is to be offered the legislature now in session. Seventy-five per cent of the profession are actively contributing to this drive.

RHODE ISLAND

The Advisory Committee to the State Department of Health on the Social Security Act met January 28. Doris A. Murray, M. D., of the Children's Bureau at Washington, who attended this meeting, stated that the social security program pertaining to child welfare was strictly educational.

A series of six or eight lectures are to be given by obstetricians and pediatricians, preferably to general practitioners in the rural districts, each lecturer receiving $25 per lecture, and the lecturers are to be exhorted to interest civic organizations in using for the treatment of the indigent any funds available.

As to the dental program, the set-up was to be similar and instructions were given by dentists to its members in the care of the deciduous teeth, the impor-

tance of oral hygiene, etc., and they too were to interest civic bodies.

SOUTH DAKOTA

With the exception of the Black Hills mining section, the dental economic condition in South Dakota is at a standstill and will remain so, or become worse, until sufficient crops turn the economic tide.

Our interallied council, composed of dentists, physicians, nurses, veterinarians, druggists and hospital executives, has for its purpose the furtherance of all matters pertaining to these groups.

A dental bill is being submitted to this session of the legislature to combat the advertiser and to place a dentist on the state board of health. In all probability, the bill will pass without opposition.

TEXAS

Dental economic conditions in Texas are improving. The outlook for 1937 is good.

The economic committees throughout the state, in nearly all of the component societies, are becoming more active and our state committee is helping the state legislative committee.

Since March 15, 1936, we have had a dental division in the state department of health, with a full-time dentist as director. Edward Taylor, director, has appointed committees in each county, which are well organized.

There is no standardized plan or method of caring for the indigent or the low wage earner. A number of counties have "county health units" and, in a few instances, dental clinics are in operation with either a full-time or part-time dentist. In other instances, the dentists have voluntarily done this work gratis. In other counties, if a child is sent to the dental office by the school authorities and the nurse, the dental work is done free. Some of the larger cities are trying to set up some plan along the line of the Washington and St. Louis plans.

The legislative committee has introduced an amendment to our present dental laws. They also are asking in this amendment that the dental board also be permitted to revoke a dental license, the revocation being subject to appeal to the courts.

VERMONT

The state board of health dentist has been making a survey of dental conditions of children in the lower grades of the rural schools. Dentists in various communities are making a similar survey. If a definite need can be shown, they hope the work may be accomplished through public health service funds. In addition to this survey, some educational work is being done in the parent-teacher association and other civic organizations.

No new dental legislation is contemplated.

No funds have been allocated to any section of the state for dental work among the indigent or the low wage earners.

VIRGINIA

An increase in business during 1936 over 1935 of 16 per cent and an increase in collections of 10 per cent were reported.

WASHINGTON

During the past year, the Washington State Health Department has appointed a dentist on the staff who works with the Federal Maternal and Child Welfare Department.

About a year ago, a plan was put in force to care for the indigent, old age pensioners, unemployables and dependent children. This plan has received considerable criticism from the profession and is in need of revision.

As the economic condition in Washington, as a whole, has improved in the past year and dental incomes have improved, no apparent demand is being made for any

form of socialized dentistry at this legislative session.

WEST VIRGINIA

The economic situation in West Virginia is improving.

Regarding dental programs, dental hygienists are doing prophylactic work in the schools and the Salvation Army in different sections is caring for emergency work (extractions) by having dentists of the particular community contribute a certain amount of their time. McDowell has what is known as the McDowell County Dental Clinic, which is handled through a levy laid by the county court through special legislation and is applicable to all school children, including high school students. The clinic service includes prophylaxis, extractions and alloy and porcelain fillings.

A bill, patterned after the Oregon law, to eliminate the advertising of dentists is now before the state legislature.

WISCONSIN

The economic situation of the dentist has, in general, improved markedly, although some cities are still considerably below normal.

Francis A. Bull, of Milwaukee, has been appointed supervisor of dental education on the staff of the state board of health.

Nothing new in the way of dental legislation or plans for providing care to the indigent or the low wage earner has been introduced.

GERMAN DENTAL LAW

A Correction

On page 1380, in your July 1936 issue, it is stated that there are no generalized educational requirements for German *Dentisten* and that only *Zahnärzte* are included in social insurance. As to this, we beg to state that the laws of the different German countries provide a professional education of seven years before admission to state examination for dentists. The prospective dentist must undergo a tutorship of three years as assistant to a dentist, after previously receiving a certificate of aptitude, and during these three years he must attend the professional classes for dental practitioners. The attendance upon such classes is enforced legally. An examination for practitioners in dentistry follows these three years of practical education. Only after having served during two more years as technical assistant is the prospective dentist allowed to attend a special professional school.

After at least one year attendance at this school, a final examination, which is a state examination, will have to be taken. This examination and a further year of practice as assistant entitles the candidate to the denomination of state-approved dentist. These dentists who have successfully passed the state examination are admitted also to social assistance under certain conditions.

Section IV of the dental law states: "The Dentist in Germany is something of an advanced laboratory man whose status has never been completely clarified and whose activities depend largely on the existing political and economic conditions." From this, it may be gathered that his status is not exact. The dentist, in his capacity as member of a state-recognized profession, can freely develop his activities. The following figures will prove this assertion:

According to the information given by the Statistical Reichsamt of January 1, 1936, there are in Germany at present: 20,641 Dentisten; 12,928 Zahnärzte, all of whom freely and independently carry out their activities with the approval of the state.

Reichsverband Deutscher Dentisten.

Berlin, January 22, 1937.

COUNCIL ON DENTAL THERAPEUTICS

ACCEPTED DENTAL REMEDIES

The following articles have been accepted as conforming to the rules of the Council on Dental Therapeutics of the American Dental Association. The Council wishes dentists to understand that the admission of an article does not imply a recommendation. A copy of the rules that govern the Council in the consideration of articles will be sent on request.

SAMUEL M. GORDON, *Secretary.*

FIBRIN FERMENTS AND THROMBOPLASTIC SUBSTANCES*

Thromboplastin Local-Squibb (J.A.D.A., 19:326 [Feb.] 1932). The following dosage form has been accepted:
Thromboplastin Local-Squibb in 4 cc. vials.

VAPOFORM ROOT CANAL PRODUCTS—CARMICHAEL, VAPOCIDE, DIFUSEPTIC, MEDISOL—NOT ACCEPTABLE FOR A.D.R.

Vapoform root canal products were considered on the initiative of the Council after renewal of the promotion of the products. The Council's referee on the product prepared the following report, which was sent to J. P. Carmichael, D.D.S., for comment. The firm did not submit any evidence to warrant a revision of the statements in the Council's report. Accordingly, the Council authorized publication of the report for the information of the dental profession.

SAMUEL M. GORDON, *Secretary.*

Vapoform root canal therapy products were promoted some years ago by the Abbott Laboratories, which entered into a contract with J. P. Carmichael, D.D.S., to merchandise the preparations. For the past three years, these products have been promoted by J. P. Carmichael, of Los Angeles, alone. The Abbott Laboratories now disclaim any connection with the enterprise. Despite the fact that the Vapoform preparations have been marketed for approximately fifteen years, a description of this method of therapy does not appear in any of the recognized textbooks on dental therapeutics.

J. P. Carmichael has recently undertaken an intensive promotion campaign for his Improved Vapoform Therapy. As far as can be ascertained, there is no difference between his original and the "improved" methods other than in the claims, which are now more elaborate and unreasonable. These new claims are set forth in a letter recently addressed to certain of the dental schools. Among other statements, the following appears in a communication from Dr. Carmichael: "Due to its penetrating and sterilizing properties, the entire area of infection becomes thoroughly and permanently immune to recurrent infection." Such a statement is obviously not based on any reproducible evidence. There is nothing in the treatment which has been shown to afford permanent im-

*A.D.R. 1935, p. 113.

munity to infection. J. P. Carmichael refers to himself as "one who has contributed in a notable way to the progress of dentistry" and states that the merits of his new method "have been conclusively proven by leading dentists all over this country and in many European cities." This bit of self-puffery can be questioned.

Vapoform is now also advertised by J. P. Carmichael in the treatment of hypersensitive dentin. He asserts that the method will ". . . allay acid bacterial action and restore the pulp to normalcy." Many other claims of questionable character appear in the advertising literature: "Vapoform will do that which has never been done in dental operations." "All stages of pulp infection present a case for Vapoform Treatment." "Each operation is completed at the one sitting regardless of blood or exudate." It is also asserted that "the degree of vitality in a deep seated cavity can be determined" by the Vapoform method. These statemetns are not supported by acceptable evidence. It is extremely improbable that they can be substantiated by objective methods.

Case histories submitted in advertising matter fail to substantiate the claims. The roentgen-ray findings are not only unconvincing as far as the claims go, but are obviously misinterpreted. Prints of roentgen-ray films offered, in one instance, to show "pulp in perfect condition" after being exposed do not include the apices of the roots. This particular case was reported as coming from one of "two prominent Los Angeles dentists whose names along with other satisfied users of Vapoform Therapy will be given on request." Apparently, some of these "prominent" dentists are easily satisfied.

Efforts to secure an exact statement of the qualitative and quantitative composition from Dr. Carmichael failed. The following statement of composition for Vapocide is noted:

Vapocide is a solution of formaldehyde, so modified by treatment with eucalyptol, thymol, methyl salicylate and glycerine that its germicidal properties are increased and its irritating properties eliminated. Vapocide is made far more powerful and penetrating by the application of heat.

The following formula for Vapocide is found in the *Journal of the Southern California Dental Society,* October, 1934:

Eucalyptal (sic)	0.616	cc.
Thymol	0.648	grams
Oleum Pinus Pumilionis	1.5	cc.
Methyl Salicylate	0.616	cc.
Glycerin	15.0	cc.
Formaldehyde (40%)	120.0	cc.

In a suitable vaporizing base containing 25% alcohol.

These statements of composition are unsatisfactory and the claims made for them are unsubstantiated by acceptable evidence. Essentially, Vapocide appears to be nothing more than a solution of formaldehyde in alcohol and glycerine. The eucalyptol, thymol, pine needle oil and methyl salicylate cannot be considered as modifying essentially the action of formaldehyde. The injudicious use of formaldehyde or mixtures containing formaldehyde in pulp canals is questionable, if not contraindicated.

Difuseptic is described as "a compound containing iodoform treated with specially prepared hard mineral wax of a very high melting point combined with zinc oxide . . . rendered radiopaque by the addition of barium sulphate . . . a surgical dressing for all wounded tissue . . ." providing "a diffusible antiseptic that is inactive except in the presence of putrefying bacteria." The latter statement is obviously wishful thinking. The following formula for Difuseptic is noted in the *Journal of the Southern California Dental Society,* October, 1934:

Iodoform Heavy	60	grams
Balsam Peru	5	grams
Barium Sulphate	60	grams

Ferric Oxide Anhydrous	1.286	grams
Zinc Oxide	60	grams
Hard Paraffin (Czecho-Slovakian)	73.75	grams
Chloroform	30	cc.
Aromatics	q.s.	

Thus, Difuseptic follows the common shotgun pattern of many root canal filling preparations. Acceptable evidence to indicate its usefulness as a filling material is conspicuous by its absence. Simpler and more acceptable combinations are available in many textbooks.

Medisol is described as "a medicated excipient with a chloroform base, modified with essential antiseptics . . . used for the purpose of producing a proper working consistency with the Difuseptic." "Medicated Asbestos Fiber and Di-Mineral Root Canal Points" are also offered as part of the drug armamentarium in the method.

It is recommended that Vapoform products (Vapocide, Difuseptic, Medisol) and the Vapoform Method be held unacceptable because the composition of the product is semisecret (Rule 1), methods for determining the constancy of composition and properties are not available (Rule 2), the products are advertised with unwarranted therapeutic claims (Rule 6), the name is not indicative of the active ingredients (Rule 8) and the composition is unnecessarily complex (Rule 10). The unscientific and irrational character of the products and the method of promotion makes it inadvisable to consider acceptance of the products.

MYNOL CREO THYMOL—NOT ACCEPTABLE FOR A.D.R.

The following report of the Council has been authorized for publication.

SAMUEL M. GORDON, *Secretary.*

Mynol Creo Thymol, put out by the Mynol Chemical Co. of Philadelphia, is a relatively recent addition to the long list of products advocated for use by, or promoted to, the dental profession for the treatment and filling of root canals.

An attempt to secure from the promoters a quantitative statement of composition brought the reply that the Mynol Company accepted the formula from Dr. A. J. Seeler of Philadelphia with the understanding that the quantitative formula would not be published. This attempt to keep the quantitative formula from being added to the common fund of knowledge is corroborated in an article on the "Possibilities of a Popular Root Flling" by Conrad and Ridgway.[1] While the article gives the complete prescriptions of other drug combinations, only a qualitative formula is given for the powder and liquid, which are said to be made according to the formula of Dr. A. J. Seeler. This article is used in advertising the product, the reprints being supplied by the firm. The following is interesting in view of the secretiveness. After referring to the paper by Conrad and Ridgway, the firm writes:

The root filling "according to the formula of Dr. A. J. Seeler" which they describe is Mynol Creo Thymol, and we are the only ones authorized to make it.

Dr. Conrad informs the Council that the product used by him was made up by a local pharmacist. At the request of the Council, he sent his working formula. The examination reported below showed that the formulas of Creo Thymol as sold by Mynol and as made up by the pharmacist are similar.

At the risk of digression, the following information is given as pertinent to the ethics

1. Conrad, W. K., and Ridgway, S. W.: D. Cosmos, 76:752 (July) 1934.

of the situation. Dr. Conrad, in cooperating agreeably with the Council, raised the question as to his legal liability in transmitting for the benefit of his fellow practitioners the formula of the products used by him and which he presumably secured from Dr. Seeler. It may be stated that, aside from the usefulness or lack of usefulness of the product, Dr. Conrad's willingness to furnish the quantitative formula of the drugs used by him was in accord with the best principles of drug usage; that is, it is not only right, but also the duty of the dentist to know what he is putting in his patient's mouth.

Mynol Creo Thymol is advertised at $3 for a package of powder and one of liquid. The following appears in a broadside:

> Mynol Creo Thymol has been endorsed by thousands of dentists in all parts of the country.
>
> It is a preparation for the treatment and filling of root canals without discoloration, and was developed after three years of research by Dr. A. J. Seeler, a member of the Phila. Clinic Club, and one of our outstanding research workers of Philadelphia.
>
> Mynol Creo Thymol reaches every one of the thousands of tubuli in a tooth. That's why it's so efficient for the treatment and filling of root canals.
>
> Exhaustive tests have proven beyond doubt that Mynol Creo Thymol penetrates the tubuli with its powerful germicidal action and permanently sterilizes the entire canal. And this is only part of its marvellous efficiency.
>
> Many of the country's best known dentists have used it continuously for over 11 years ***with amazing success.***

The name of A. J. Seeler does not appear in the Periodical Index to Dental Literature for the years 1925-1932, nor is it found in the indices of THE JOURNAL OF THE AMERICAN DENTAL ASSOCIATION, *Dental Cosmos* or *Journal of Dental Research* for the period 1931-1936.

The evidence in support of the wide germicidal claims is that *B. typhosus* was killed by exposure to the "disinfectant under examination" and that eighteen hours of contact of grindings from a decayed tooth with Creo Thymol (whether liquid or powder is not stated) rendered a culture sterile. No evidence is published of bacteriologic examination of treated teeth *in situ*.

The Mynol Chemical Company did not respond to the invitation to submit the product for the consideration of the Council. Accordingly, examination was made in the A.D.A. Bureau of Chemistry. The chemist reports that Mynol Creo Thymol powder can be simulated by mixing zinc oxide, 50 parts, bismuth subnitrate, U.S.P., 30 parts, iodoform, U.S.P., 10 parts, and rosin, U.S.P., 10 parts, all by weight. The liquid part could be made by dissolving thymol, U.S.P., 12.5 gm., creosote, U.S.P., 10 cc. and eugenol, U.S.P., 64 cc. This agrees with the statements of composition furnished by Dr. Conrad.

It is little wonder that the quantitative composition is not divulged by the promoters. At current market prices, 1-pound lots of the powder, containing almost sixty-four times as much as in a trade package, can be made for the cost of one-quarter ounce bottle of Creo Thymol Powder. The cost of the liquid is also far out of true reach of the cost of the ingredients if made by a dentist or a pharmacist. Herein lies the answer as to who pays for advertising the product.

Mynol Creo Thymol is offered as a root canal treatment and filling product in one. It need hardly be stated that regardless of differences in technic, most careful root-canal therapeutists no longer countenance such mixtures. They appreciate that such mixtures, from the very nature of affairs, cannot be expected to be permanently germicidal as claimed; nor do these mixtures retain their original volume, as some of its components disappear into the tissues. Permanency in volume and in sealing must be obtained after aseptic operative procedures by the use of inert materials, such as guttapercha.

Thus, Creo-Thymol Root Canal Filling is unacceptable because: (1) a quantitative statement of composition is not given by the promoters (conflict with Rule 1); (2) methods for controlling the identity and constancy of the composition are not given (conflict

with Rule 2); (3) unwarranted and exaggerated statements are made in the promotion (conflict with Rule 6); (4) the name does not indicate to the user the composition of the product, and there are no reasons that dentists should acquiesce in a proprietary name for a mixture of well-known substances, requiring no great pharmaceutic skill for compounding (conflict with Rule 8), and (5) the mixture is promoted as a root-canal treatment and filling which is not in accord with conservatively accepted information, and therefore it is unnecessarily complex and unscientific (conflict with Rule 10). The chemist's report follows.

MYNOL CREO THYMOL

Four original packages of Mynol Creo Thymol Root Canal Treatment and Filling, price $2.50 each, were purchased on the open market for examination.

The following appeared on the carton:

Formula of A. J. Seeler, Ph.D. (sic), D.D.S. Antiseptic, Germicidal, Sedative, Radiopaque, Permanent but removable. Ingredients: Iodoformum, Eugenol, Creosotum, Bismuth, Thymol, Zinc Oxidum, Resina.

In each package was a package containing a powder and liquid preparation.

The following appeared on the circular enclosed in each package:

Formula of A. J. Seeler, D.D.S., Ph.G. (sic.) Uses: 1. Sterilization of Cavities. 2. After Devitalizing Exposed or Non Exposed Pulps. 3. Treatment of Putrescent Conditions. 4. Lining for Deep Cavities. 5. Treatment of Exposed Pulps in Deciduous Teeth.

Special Note. If you should force any portion of Creo Thymol Root Canal Treatment and Filling beyond the apex during the treatments there is likely to occur some inflammation. Do not become alarmed because of this. If the patient complains of soreness, a simple remedy is to apply cotton rolls and dry the area. Apply tincture of aconite. The inflammation may continue, in severe cases, for twenty-four hours.

Powder

Each package contained approximately 8.7 gm. (about one quarter ounce) of a canary-yellow powder with a pronounced odor of iodoform.

Qualitative examination indicated the presence of bismuth, zinc, nitrate, iodoform and a substance with properties of rosin. The zinc was presumably present as zinc oxide as indicated by the ash—yellow when hot, dirty white when cool.

Quantitative determinations yielded:

Ash (750 C.)	**23.5 per cent**
Benzene extract	**16.6 per cent**
Iodoform	**9.7 per cent**
Acid insoluble (resinous)	**10.6 per cent**
Bismuth (as Bi_2O_3)	**24.9 per cent**
Zinc (as ZnO)	**50.6 per cent**

From the foregoing, it may be concluded that a mixture having the essential properties of Mynol Creo Thymol powder may be made by intimately mixing zinc oxide, U.S.P., 50 parts, bismuth subnitrate, U.S.P., 30 parts, rosin (finely powdered), 10 parts, and iodoform, 10 parts by weight.

Liquid

Each package contained 15 cc. (approximately one-half ounce) of a pale straw colored liquid, which darkened on standing and which possessed a predominating odor of creosote.

The specific gravity was 1.068 and the refractive index 1.5340.

Qualitative tests for formaldehyde yielded negative results. One drop dissolved in 2 cc. of alcohol and treated with 1 drop of ferric chloride T.S. yielded the following color changes: emerald green, blue, olive green. The presence of thymol was indicated

by a positive reaction to Lambert's test (Merck's Reagenzien-Verzeichnis, 1932, p. 351). A quantity was subjected to distillation. A sharp break in the boiling point was not observed.

A synthetic preparation made up by mixing: thymol, U.S.P., 12.5 gm.; creosote, U.S.P., 5 cc., and eugenol, U.S.P., 32.5 cc., was compared with Creo Thymol Liquid. The following results were obtained:

	Creo Thymol	"Synthetic"
Specific gravity	1.06	1.04
Refractive index	1.5340	1.5341
Tensiometer reading	37.5	37.0
Methoxyl ($-OCH_3$)%[2]	13.8	13.9

From the foregoing, it may be concluded that a preparation made up as stated above has chemical and physical properties similar to those of Creo-Thymol Liquid.

2. Phillips, Max: Quantitative Determination of Methoxyl, Lignin and Cellulose in Plant Materials, J. A. Official Agr. Chem., 15:118 (Feb.) 1932.

BUT DENTISTS DON'T USE—POWDER

The following resolution of the Raleigh (N. C.) Dental Society was unanimously adopted by the North Carolina Dental Society at its annual meeting in May, 1936:

Whereas, we, as members of the dental profession, feel that one of our most important health service duties is to educate our people in the proper care of their teeth; and

Whereas, the Dr. Lyon's Tooth Powder, manufactured and sold by the R. L. Watkins Company, Newark, N. J., in their radio advertisement repeatedly makes the statement that "ninety per cent of the dentists clean teeth with powder," which we believe is incorrect and unfair to our profession; therefore, be it

Resolved, that we, the members of the Raleigh Dental Society, condemn and label as untrue the statement made by the radio announcer on the national program of the R. L. Watkins Company, and further suggest that a true statement of the facts will place both the dental profession and dentifrice manufacturers in a position more to be desired; and be it further

Resolved, that a copy of these resolutions be mailed to the R. L. Watkins Company, a copy to the Secretary of the American Dental Association, and a copy to the secretary of the North Carolina Dental Society with a request that same be acted upon at the next meeting of the North Carolina Dental Society.

Accepted Dental Remedies, 1935, states:

There is no essential difference in the cleansing properties of a tooth powder over a tooth paste. Indeed, it is well known that pumice or silica used for prophylaxis is made into a paste with glycerin or water before application to the teeth.

Furthermore, the statement carries misleading information to the uninformed. Oral prophylaxis, as practiced by careful dentists, is more than applying powder or paste to the teeth.

BIBLIOGRAPHICAL DEPARTMENT

"The 1936 Year Book of Dentistry"

Edited by Charles G. Darlington, M.D.; George W. Wilson, D.D.S.; Howard C. Miller, D.D.S.; Charles Lane, D.D.S.; George M. Anderson, D.D.S. Published by The Year Book Publishers, Inc., 304 South Dearborn Street, Chicago. Price, $3.

"The Year Book of Dentistry" is a new venture in the dental literary field and undertakes a yearly survey of the dental literature of the world in a similar manner to that of the well-known "Practical Medicine Year Books," which have for many years reviewed the literature of the various specialties of medicine.

At a stage in the development of dentistry when we are endeavoring to establish more firmly the distinctive autonomy of the specialty of dentistry, it is at first rather disconcerting to find that the chief editor of the year book is a medical man. One soon discovers, however, in reading the section edited by Dr. Darlington, that he is thoroughly familiar with the dental literature on his subject and displays a rather unusual understanding of the problems of dentistry, as well as those problems which have a common interest from both the medical and the dental aspect.

The purpose of the book, as stated in the introduction, is a comprehensive review of the literature of each phase of dentistry in such manner as to record the advances of dentistry during the year in their practical application to the clinical aspect of dental practice. With this objective in view, the general field of dentistry has been classified under five subdivisions: "Diseases of the Mouth"; "Pathology and Research"; "Operative Dentistry"; "Oral Surgery"; "Prosthetics," and "Orthodontics," and the review of the literature on each of these phases of practice has been delegated to a practitioner well qualified to speak authoritatively on his assigned subject.

The editors of the various subdivisions of dental practice have selected and presented in condensed form what they consider to be the outstanding contributions in their different fields and have justified the selection of the articles by pertinent editorial comment on many of the articles. These comments would seem to indicate a thorough familiarity on the part of the commentators with the trend of advancement in the various phases of dental practice.

Altogether, this effort to present a comprehensive review of the yearly literary output is a very worthy one, and will prove of much value to those whose time limitations prevent as close touch as desirable with the literary product of dentistry. The price, $3, is well within the means of every practitioner and the "Year Book" will afford him a ready and valuable reference work for use in his daily practice.

We commend the editors and the publishers on the result of their first efforts in this rather ambitious undertaking.

"The Pharmaceutical Recipe Book"

Second Edition. (R. B. II.) By authority of the American Pharmaceutical Association. Prepared by the Committees on Recipe Book and on Unofficial Formulas of the American Pharmaceutical Association. Published by The American Pharmaceutical Association, 1936. Price, $5.

The purpose of the "Recipe Book," as stated by the committee in charge of its production, is to supply definite formulas for those preparations which are not included in the official books (The U. S. Pharmacopoeia XI and the National Formulary VI), but which are still in fairly common demand in the retail phar-

macy, in the hospital pharmacy and in the manufacture of products relative to which druggists are called on for advice or supply. In other words, to keep alive many useful and tried formulas which have been more or less supplanted by more modern preparations, but which are still in demand by those who favor the use of many of the so-styled old-fashioned remedies. It is in essence a useful companion to the "Pharmacopoeia" and the "Formulary," but unofficial.

The first edition, published in 1929, contained some 1,600 formulas, and was soon exhausted. The present second edition has been considerably enlarged and contains some 2,000 formulas, comprising pharmaceutic formulas, hospital formulas, dental formulas, diagnostic reagents and clinical tests, veterinary formulas, photographic formulas, cosmetic formulas, flavoring formulas and technical formulas. In fact, the book is a veritable storehouse of formulas to meet practically every therapeutic need. Copies of the book can be obtained from the Mack Printing Co., Easton Pa., authorized printers and distributors.

"What Is Wrong with British Diet?"

> Being an exposition of the factors responsible for the undersized jaws and appalling prevalence of dental disease among British peoples. By Harry Campbell, M.D., Fellow of the Royal Anthropological Institute. London: William Heinemann, Ltd. Price, 10/6 net.

The author has undertaken a very serious and intensive study of the diet of the British peoples, with a view to determining its influence on the prevalence of dental disease and on the development of the jaws. In this book, he comments on practically all types of diet, and compares the health qualities of the diet, particularly of races which subsist on a predominant meat diet and those which depend on the so-called more civilized diet, in which starchy foods comprise the main bulk. In this latter class he places the British peoples, and the comparison is not at all favorable to the starch-eating peoples.

With regard to dental disease—dental caries—the author notes that we have long been taught that starchy foods are largely responsible for this condition, and the observations of those who have studied the problem seem overwhelmingly unanimous in this conclusion. He also comments on the growing tendency toward a more general adoption of the vegetable type of diet, and the comparison of this type suffers also with that of the meat diet. In fact, Mr. Campbell leans perceptibly toward the meat diet as being what he considers man's natural diet in the proper development of the body and the maintenance of healthful conditions.

He very ably supports his contention that the jaws require exercise and therefore need more or less a meat diet for their development; and here again the comparison of the starch-eaters, or prepared civilized food addicts, with the meat-eaters is quite favorable to the latter. While the author recognizes the value of mouth hygiene as a deterrent to dental caries, he places more dependence on the character of the food in maintaining the teeth in a healthy condition.

Altogether, Mr. Campbell's thesis is one of the ablest arguments that we have heard recently in favor of masticatory exercise of the teeth and jaws as the all-important factor in maintaining the health of the former and the health and proper development of the latter. While agreeing with him in his views of the jaws and teeth and also as to the comparative value of the types of diet, we are inclined to believe that he is overly pessimistic regarding the future and does not take into full account the wonderful adaptability of the body to the various types of diet.

The author's views on diet are indeed sound, as we see it today, and well worthy of the serious consideration of those who are engaged in the study of this, at present, little understood problem.

"Operative Dentistry"

> A revision of G. V. Black's Work, with which his "Special Dental Pathology" is combined. By Arthur D. Black, A.M., M.D., D.D.S., Sc.D., Dean and Professor of Operative Den-

tistry and Oral Pathology, Northwestern University Dental School. In four volumes: Volume I. Pathology of the Hard Tissues of the Teeth, Oral Diagnosis, 422 pages, 280 illustrations; Volume II, Technical Procedures in Making Restorations in the Teeth, 313 pages, 350 illustrations; Volumes III, The Treatment of Dental Caries, 305 pages, 492 illustrations; Volume IV, Pathology of the Diseases of the Investing Tissues of the Teeth, the Dental Pulp and the Periapical Tissues, 472 pages, 523 illustrations. Price $4.50 per volume; $16.00 for the set. Seventh Edition. Medico-Dental Publishing Co., Chicago; Henry Kimpton, London; 1936.

The enormity of this work, containing as it does in the four volumes 1512 pages of text and 1645 illustrations, would at first glance appear to consist of an inordinate amount of text material devoted to one phase of dental practice. One soon realizes, however, in reading the book, that the subject is treated in such an exhaustive manner in all of its various aspects that there is no superfluity of text, nor is there much left to be said on the subject.

When one considers the scope of G. V. Black's effort in the operative field of dentistry and bears in mind that this notable contribution to the textbook literature of dentistry undertakes to record practically all of Dr. Black's scientific efforts, the voluminous character of the work is readily appreciated. With this thought in mind, the ambitiousness of the undertaking of revising such a comprehensive treatment of the subject can also readily be appreciated, and only one with the heritage and training which resulted in a mental trend and an infinite capacity for work similar to that of the original author could have accomplished the task in such an admirable manner as is here represented.

Volume I comprises Dr. G. V. Black's distinctive work on the "Pathology of the Hard Tissues of the Teeth" and "Surgical Disorders of the Mouth, Jaws and Salivary Glands"; a chapter on "Health, Nutrition and Hygiene" by Clara M. Davis, M.D., and the valuable work done in collaboration with F. S. McKay, D.D.S., on "Mottled Enamel."

It is indeed reassuring to note the amount of space devoted to the examination of the mouth and the recording of results thereof as leading to an intelligent diagnosis of mouth conditions. This is a phase of the dental practitioner's obligation to the patient that has been much neglected. If the dentist generally would follow the valuable suggestions offered by Dr. Black, in making and recording an intelligent examination of the mouth, a much needed step forward would be made toward removing the stigma on the average dentist involved in the saying that few dentists can see beyond the cavity in the tooth.

The chapter on "Nutrition and Diet" by Dr. Davis is an exceedingly valuable addition to the study of diet in its influence on the development of the teeth and its relation to caries. This chapter summarizes not too briefly the present-day status of our knowledge of diet in its causal relation to diseases of the teeth and mouth, and is interpreted by one who is an authority on the subject.

The chapter on "Mottled Enamel" by Dr. McKay presents in condensed form the sum of our knowledge of the chemical content of drinking water in its relation to mottled enamel, and offers a most practical suggestion for the correction of the condition.

The chapter on "Caries" comprises an elaborate summary of the notable work of G. V. Black in his scientific and clinical experiments toward the solution of the cause of caries, which led to the evolution of the system of cavity preparation that bears his name. Dr. Black's work on the susceptibility of the teeth to dental caries and the etiology of the process and the manner in which it proceeds represents today, as when it was first presented, practically the limit of our knowledge of the subject.

On the whole, this text on pathology of the hard tissues of the teeth represents the scope of knowledge on this subject, the possession of which is the incumbent duty and responsibility of every dentist who undertakes restoration of the teeth.

Volume II presents, as a logical sequel to the study of the pathology of the hard tissues of the teeth, an elaboration of the technical procedures involved in dental restorations. Here will be found a new chapter on "Materials Used in Operative Dentistry," by Eugene W. Skinner, Ph.D., presenting in lucid detail a study of the characteristics, composition and qualities of the various materials used in filling teeth, as well as a consideration of the adaptability of the various materials for the purposes for which they are used. Dr. Skinner has here made a notable contribution toward a better understanding of the metallurgic and chemical aspects, particularly of gold and cements.

The balance of Volume II is devoted to the presentation of G. V. Black's principles of cavity preparation so generally in use throughout the world and which stand today as the most conspicuous advance in operative procedure made in the development of this phase of dental practice. Then follows the Black technic for the insertion of gold foil, a filling procedure that has stood the test of time, and for which there is yet no satisfactory substitute.

The author places particular emphasis on the necessity of keeping the operative field free from moisture and, to this end, presents a technic for the use of the rubber dam which conforms quite fully to our most recent knowledge of the anatomic relations of the soft tissues to the teeth.

Volume III is devoted to a consideration of the hygienic care of the mouth, which embodies the latest conception of oral prophylaxis, including the treatment of dental caries by restoration, as well as the most practical and painless methods of operative procedure, even to the inclusion of the latest painless procedure introduced by Hartman.

Much space is devoted to the care of the teeth of children, and here Dr. Black has elaborated a technic for the care of what he calls the temporary teeth which, if followed by those who read the text, will go far toward the preservation of these teeth until the time for the eruption of their successors.

Incidentally, we are much surprised to find in a book as up-to-date as this one the use of such a term as "temporary teeth." The author has, in the use of this and several other terms, failed to follow the modern trend in dental nomenclature.

Volume IV comprises in substance the text of Dr. Black's original contribution to the study of "Special Dental Pathology," with revisions in accord with the later developments in this field. Particular attention has been given to a study of what the author designates as pressure pericementitis, a pathologic condition of the investing pericementum resulting from excessive occlusal stress.

Finally, the chapter on "Focal Infection," by Edward H. Hatton, B.L., M.D., is a most fitting termination of a notable contribution to the literature of dentistry. Dr. Hatton has very concisely reviewed the rise and decline of radicalism in the treatment of the pulpless tooth in its relation to focal infection, and concludes with the statement that "opinion in the light of a quarter of a century of experience with the problem is being consolidated in a somewhat conservative form." L. P. A.

CURRENT LITERATURE

Oral Tuberculosis Lesions

By C. C. DARLINGTON and I. SALMAN

IN order for tuberculosis to develop, there must be tubercle bacilli or their products present and there must be lowered resistance. Since most evidence points to tuberculous lesions as secondary to infection elsewhere, the question of transportation becomes important. Mechanical extension, direct extension, lymphatic distribution and blood stream dissemination must be considered. Twenty-seven cases (fifteen ambulatory and twelve hospitalized) were studied and classified with the above-mentioned points in mind. They are listed under (1) tooth-apex or socket cases (twelve); (2) mucous membrane cases (ten); (3) tuberculous osteomyelitis (one); (4) tuberculous lymphadenitis (one), and (5) cases presenting difficulty in diagnosis (four). Case histories are summarized individually and given in tabular form. Biopsy was used as a method of diagnosis in twenty-five of the cases. The authors conclude that oral tuberculous lesions (1) may have dental application, (2) are usually secondary to advanced pulmonary tuberculosis, (3) present a typical histologic picture, which may be simulated by syphilis and (4) fall into two main groups: (*a*) apex or socket cases, which most frequently show bone destruction and are spread by the blood-stream and (*b*) mucous membrane cases, which involve the gingiva and may lead to tooth loosening and are spread by direct and lymphatic extension, in addition to transportation by the blood stream, and that mucous membrane cases frequently have laryngeal involvement with particularly grave prognosis. It is believed that the sputum is of little importance as a factor in mouth infection.—*Am. Rev. Tuberc.*, 35:147, February 1937.

HAMILTON ROBINSON.

Clinical Use of Cyclopropane

By U. H. EVERSOLE, L. F. SISE and P. D. WOODBRIDGE

THE anesthetic properties of cyclopropane were discovered by Henderson and Lucas, of Toronto, but the first clinical study of this agent was that of Waters and his associates at the University of Wisconsin. Cyclopropane is a cyclic hydrocarbon gas with the empiric formula C_3H_6. The anesthetic is absorbed through the lungs quite rapidly, and unconsciousness is usually reached in from one to two minutes. Elimination from the blood is rapid, the patient gaining consciousness in from two to ten minutes after the mask is removed. The combination of low toxicity, rapidity of action and considerable power even when it is mixed with a surplus of oxygen gives cyclopropane a unique position among the general anesthetics. Its use is particularly advantageous for operations wherein moderate relaxation is desired, for intratracheal anesthesia, for supplementing other anesthetics, both general and spinal, and for the several varieties of cases in which an abundant supply of oxygen is desirable. The chief toxic effect appears to be a temporary disturbance of the heart, usually evident only in the deeper stages of anesthesia. The signs of depth of anesthesia are roughly parallel to those of the other inhalation anesthetics. The technic of administration is radically different from that of nitrous oxide and ethylene.—*Surg. Gynec. & Obst.*, 64:156, Feb. 1, 1937.

J. FRANK HALL.

Adenocystoma Lymphomatosum of Salivary Glands

By P. N. HARRIS

THIS comparatively rare tumor usually appears in the fifth or sixth decade. It is six or seven times more common in the male and is found in the region of the paro-

tid and submaxillary glands and at the angle of the jaw. Only two malignant cases have been reported. The tumor may be solid or partly cystic. It is composed of columnar epithelial cells which form tubular alveoli or clefts and cystic spaces with papillary projections. The author reports two cases, one in the parotid gland of a man aged 61, the other attached to the parotid gland of a man aged 62.—*Am. J. Path.*, 13:81, January 1937.

HAMILTON ROBINSON.

Therapeutics of Maggot Active Principle

By S. K. LIVINGSTON

OVER a six-year period, 1020 cases of chronic suppuration have been treated by maggot therapy: 415 by living maggots and maggot active principle in combination and 605 by maggot extract alone. Maggot extract was found to contain active healing agents and embryonic growth-stimulating substances. From 60 to 100 per cent of the cases showed clinical improvement through growth stimulation and pathogenic bacterial inhibition. The extract remains stable at room temperatures, is a more powerful growth stimulant than any of its ingredients and has wider application than living maggots. Clinical trial in 1020 cases proved its therapeutic value.—*Am. J. Surg.*, 35:554, March 1937.

HAMILTON ROBINSON.

Protective Action of Human Saliva

By J. L. T. APPLETON

THE effect of saliva on the pathogenicity of *Serratia marcescens (B. pyocyaneus)* was tested by injecting into mice cultures of the organisms (1 part) with or without admixtures of centrifuged saliva (6 parts). In all, 200 mice were injected. Fifty per cent of the group receiving cultures of the organism alone died; whereas, only 21 per cent receiving both culture and saliva succumbed within the test period. It was found that the mice receiving saliva with the organisms showed a lower mortality, a longer survival period and fewer positive heart cultures.—*Ztschr. f. Stomatol.*, 35: 18, 1937.

B. G. BIBBY.

Eugenic Significance of Congenital Clefts of Lip, Jaw and Palate (Die eugenische Bedeutung der angeborenen Spaltbildungen im Bereiche von Lippe, Kiefer, und Gaumen). 1935

By K. HAENTZSCHEL. LEIPSIC (DISSERTATION)

THIS monograph is based on very extensive studies, observations and investigations in 128 cases of cleft lip, jaw and palate. Facial clefts are the most common of all the congenital deformities. The so-called healed intrauterine cleft palate, a cleft-like defect in the bone, can be distinguished only by palpation. The theory that such defects may result from psychic trauma has been definitely disproved. Thirty-five and one-tenth per cent of all cases show additional anomalies and deformities, especially a slight degree of congenital feeblemindedness. The latter defect occurs in 11.7 per cent of persons with clefts. The relatives of one-fifth of all persons with cleft defects are affected through heredity by nervous diseases, epilepsy or feeblemindedness. In all cases, the average operative result is only fair. Good speech was attained in only 7 per cent of the reviewed cases. More than half of the married patients with clefts were married to definitely inferior partners. All forms of cleft formation, from the slightest cleft lip to the pronounced cleft of the hard palate, must be considered hereditary afflictions. Operative correction cannot overcome the pathologic hereditary tendency. In conclusion, the author says that as the theory of hereditary genesis must be regarded as valid in all cases, sterilization of all individuals with clefts should be demanded.—*Surg. Gynec. & Obst.*, 64:111, Internat. Abstr., Feb. 1, 1937.

J. FRANK HALL.

Research on Gold Casting

By W. E. HERBERT and A. R. F. THOMPSON

THE authors undertake a critical examination of the processes involved in the casting of gold. These are divided into impelling forces (steam pressure and gravity, and impeding forces), resistance to expulsion of air from the mold space, surface resistance

of the investment and the viscosity of the gold. With a view to improving castings, they studied, by means of special apparatus, the amount and rate of build-up of steam pressure, the rate of solidification of gold in the mold and the mode and rate of disposal of air from the mold space. They found that the use of cristobalite investments produced castings up to 0.4 per cent larger than the pattern, but that this investment has a disadvantage in that it is only half as porous as silica plaster mixtures. The normal steam pressure developed in Solbrig casting systems reaches 20 pounds per square inch, but this may be increased up to 50 pounds by using methylated spirit or carbon tetrachloride on the asbestos pad. If contact with the asbestos pad is avoided, the gold in the mold space can be relied on to solidify before that in the crucible.—*Proc. Roy. Soc. Med.*, 30:245, 1937.

B. G. Bibby.

Micrognathia in New-Born

By Paget Lepage

Once recognized, micrognathia is an obvious deformity because of the small size of the lower jaw. Babies suffering from it may die and the condition be diagnosed as inanition and congenital heart disease. There is great difficulty in respiration, and attacks of cyanosis result from the tongue falling back and obstructing the throat. The causation is discussed. When there is not hereditary micrognathia, patients may recover with suitable exercise and management. The treatment advocated consists of feeding the child with the face downward and the use of appliances on feeding bottles which make it necessary to throw the chin forward. Splints and mechanical appliances have been used. A fatal case is recorded.—*Lancet*, 232:323, 1937.

B. G. Bibby.

PRACTICE IN PARAGRAPHS

This department is intended for busy readers. It aims to tell a vivid story in a few words. Items should be of a practical character, and free from padding—not more than a paragraph or two. We exact no limit, but two hundred words can tell most of these stories. Send in your ideas; they will be welcome.

Gagging—Before taking an impression, the patient should be carefully instructed as follows: "When I put the impression tray in your mouth, start to breathe in through your nose and out through your nose. Breathe slowly and deeply until the impression is removed. Forget about what is taking place in the mouth. As you finish each exhalation, concentrate on the next one." This type of breathing, with instructions to the patient to concentrate on it and think of nothing else, will overcome the worst case of gagging.—*J. Leo Epstein, Brooklyn, N. Y.*

Setting Orthodontia Bands—In setting orthodontia bands, a crown is made out of the band by placing a piece of slightly tinted cellophane between the surface of the index finger and the occlusal surface of the band. This permits thorough coating of all interior surfaces of the band, placing in position on the tooth and pressing to place without getting any extra cement on the finger. Be sure that all surfaces are thoroughly sealed before removing the cellophane and that no surplus cement has been left under the free margin of the gum.—*T. M. Robertson, Coffeyville, Kan.*

Appointments—If you have for some reason kept the patient waiting very long after the appointment time, the patient deserves an apology from you just as you from the patient when he is late or cancels an appointment.—*J. Leo Epstein, Brooklyn, N. Y.*

First Permanent Molar—Most mothers will appreciate instructions and illustrations regarding the importance of this tooth. The dentist can save himself a great deal of time and energy in explaining this and many other important points about children's teeth, if he will give each mother a copy of the A.D.A. Booklet, "Good Toothkeeping." It is the finest booklet of its kind, covering the subject of the care of the child's teeth, the subject being accompanied by pictures and diagrams, so that any person will clearly understand it.—*J. Leo Epstein, Brooklyn, N. Y.*

Dentifrices—Claims galore have been made for various dentifrices in behalf of their film removing astringent, antiseptic, germicidal, emollient, deodorizing and gum hardening properties. Seldom is mention made of the necessity of maintaining brightness of the metallic dental prostheses themselves. Brightness is synonymous with cleanliness and cleanliness is conducive to permanence. If a "clean tooth does not decay," a clean and polished filling or inlay is less apt to permit recurrence of caries. All other factors being equal, it is reasonable to expect metallic brightness to contribute to the longevity of the filling and of the tooth. All dentifrices should contain a metal brightening ingredient, which would cause restorations to look better and last longer.—*Herbert Ely Williams, Red Bank, N. J.*

Denture Patients—Sensible and reasonable preliminary education is far more effective for prospective denture patients than the most profuse postmortem statements. Great disappointment often results from greater expectations. The fitting of temperaments often requires far greater resourcefulness than the fitting of difficult ridges. Full denture patients generally handle their food by mauling, rolling, shifting, teasing, mashing, crushing and other unconscious mandibular movements of their own, foreign to natural teeth. Tongue pressure against the denture does the rest. Prosthetic pressure of 25 pounds against 150 pounds of natural force is self-explanatory. Physicians contend that patients who enjoy ill-health are the most difficult to treat. Indifferent denture patients lacking cooperation and sympathetic understanding are uncertain, unfavorable prospects for the successful application of the prosthetic art.—*Herbert Ely Williams, Red Bank, N. J.*

New Uses for Analgesia—1. In lancing small superficial abscesses within the oral cavity, which require only the quick thrust of a sharp scalpel, gas anesthesia can be given with great satisfaction. The danger of inhalation of pus, which may occur under full anesthesia, is avoided, and the operation is painless. This method is more satisfactory than ethyl chlorid anesthesia, which freezes the tissues, making incision difficult, and as far as anesthesia is concerned is not much more effective than the use of water. 2. If the tissues about a tooth have been satisfactorily anesthetized with procaine, but the peridental membrane refuses to be stilled, and if, for any reason, full anesthesia is contra-indicated, gas anesthesia during application of the forceps will complete the anesthesia. Further work on the bone under the procaine which has been given will not be painful.—*Bernard P. Morgenstern, 240 E. Seventy-Ninth St., New York City.*

ANNOUNCEMENTS

ANNOUNCEMENTS must be received by the fifth day of the month in order to be published in the forthcoming issue of THE JOURNAL.

CALENDAR OF MEETINGS

American Dental Association, Atlantic City, N. J., July 12-16.

American Academy of Periodontology, Atlantic City, N. J., July 8-10.

American Academy of Restorative Dentistry, Atlantic City, N. J., July 10-11.

American Board of Orthodontia, Chicago, Ill., April 17.

American Society for the Promotion of Dentistry for Children, Atlantic City, N. J., July 12.

American Society of Oral Surgeons and Exodontists, Atlantic City, N. J., July 9-10.

American Society of Orthodontists, Chicago, Ill., April 19-22.

Association of American Women Dentists, Atlantic City, N. J., July 12-16.

Academy of Anesthesiology in Oral Surgery, New York City, April 21.

International Association for Dental Research, Baltimore, Md., March 13-14.

American Society for the Advancement of General Anesthesia in Dentistry, New York City, fourth Monday in March and October.

National Board of Dental Examiners, May 7-8.

New York Society of Dental History and Culture, New York City, April 14.

North Atlantic Orthodontia Society, New York City, April 21.

St. Louis (Mo.) Dental Alumni Association Annual Reunion, March 31-April 1.

Thomas P. Hinman Midwinter Clinic, Atlanta, Ga., March 15-16.

University of Louisville Centennial, Louisville, Ky., April 5-7.

District of Columbia at George Washington University, Washington, D. C., second and fourth Tuesdays in each month from October to June, inclusive.

Cleveland (Ohio) Dental Society, May 3-4.

Australian Dental Congress, Sydney, August 16-20.

International Dental Federation, Stockholm, Sweden, August 9-14.

American Dental Society of Europe, Paris, France, August 2-5.

European Orthodontic Society, Brussels, Belgium, May 17-18.

Ontario (Canada) Dental Association, Toronto, May 17-19.

American Dental Assistants Association, Atlantic City, N. J., July 12-16.

American Dental Hygienists Association, Atlantic City, N. J., July 12-16.

STATE SOCIETIES

April

Alabama, at Mobile (12-14)
Arizona, at Phoenix (23-24)
California, at San Joe (12-14)
Kentucky, at Louisville (5-7)
Louisiana, at New Orleans (8-10)
Massachusetts, at Boston (26)
Michigan, at Detroit (26-28)
Mississippi, at Jackson (5-7)
New Jersey, at Atlantic City (24)
Oklahoma, at Tulsa (4-7)
Wisconsin, at Milwaukee (19-22)

May

Arkansas, at Little Rock (10-12)
Connecticut, at Hartford (12-14)
Georgia, at Savannah (17-19)
Illinois, at Springfield (11-13)
Indiana, at Indianapolis (17-19)
Iowa, at Des Moines (4-6)
Kentucky, at Louisville (5-7)
Maryland, at Baltimore (3-5)

Missouri-Kansas, at Kansas City, Mo. (16-19)
Montana, at Anaconda (6-8)
Nebraska, at Omaha (17-19)
New York, at New York City (4-7)
North Carolina, at Pinehurst (3-5)
North Dakota, at Fargo
Pennsylvania, at Pittsburgh (4-6)
South Dakota, at Mitchell (10-11)
Tennessee, at Knoxville (10-13)
Texas, at Houston (17-20)
Vermont, at Burlington (19-20)
Virginia, at Virginia Beach (10-12)
Washington, at Bellingham (3-5)
West Virginia, at Bluefield (17-19)

June

Colorado, at Colorado Springs (10-12)
Idaho, at Boise
Maine, at Rangeley (25-26)
Nevada, at Reno (5)
New Hampshire, at North Conway (21-22)
New Mexico, at Albuquerque
Panama, at Colon (12)
Oregon, at Portland (23-25)
South Carolina, at Columbia (14-15)
Utah, at Logan (10-12)
Wyoming, at Casper (21-22)

September

Southern California, at Los Angeles (13-15)

November

Florida, at Hollywood (4-6)
Ohio, at Columbus (8-10)
Puerto Rico, at San Juan

December

Hawaii, at Honolulu

STATE BOARDS OF DENTAL EXAMINERS

Alabama, at Birmingham, June 21. James A. Blue, 1016 Comer Bldg., Birmingham, Secretary.

California, at San Francisco, May 24, and at Los Angeles, June 21. Kenneth I. Nesbitt, State Bldg., San Francisco, Secretary.

Connecticut, at Hartford, June 22-26. Almond J. Cutting, Southington, Recorder.

Delaware, at Wilmington, July 7-9. Charles R. Jefferis, 709 Medical Arts Bldg., Wilmington, Secretary,

Florida, at Jacksonville, June 21. H. B. Pattishall, 351 St. James Bldg., Jacksonville, Secretary.

Indiana, at Indianapolis, June 15. J. M. Hale, Mt. Vernon, Secretary.

Kentucky, June 15-18. Robert L. Sprau, 970 Baxter Ave., Louisville, Secretary.

Louisiana, at New Orleans, June 14-18. Joseph L. Webre, 740 Audubon Bldg., New Orleans, Secretary.

Maine, at Augusta, June 28-30. Fred B. Wheaton, 319 Main St., Biddeford, Secretary.

Minnesota, at Minneapolis, June 18-24. Paul Hagen, Crookston, Secretary.

Mississippi, June 15. A. B. Kelly, Yazoo City, Secretary.

Montana, at Helena, June 28-July 1. Leonard A. Jenkin, 214 Medical Arts Bldg., Great Falls, Secretary.

New Jersey, June 28-July 2. Walter A. Wilson, 148 W. State St., Trenton, Secretary.

New Mexico, at Clovis, June 16-18. J. J. Clarke, Artesia, Secretary.

North Dakota, at Fargo, July 12-15. W. E. Cole, Bismarck, Secretary.

Ohio, at Columbus, June 28. Morton H. Jones, 1553½ North Fourth St., Columbus, Secretary.

Pennsylvania, at Philadelphia and Pittsburgh, July 15-19. W. A. McCready, Highland Bldg., Pittsburgh, Secretary.

South Carolina, at Columbia, June 10-12. T. C. Sparks, Medical Bldg., Columbia, Secretary.

South Dakota, at Sioux Falls, June 28-July 1. H. W. Thomas, Aberdeen, Secretary.

Vermont, at Montpelier, June 28-30. H. B. Small, Burlington, Secretary.

Virginia, at Richmond, June 15. John M. Hughes, 715 Medical Arts Bldg., Richmond, Secretary.

West Virginia, at Charleston, June 28-30. Henry C. Hill, Dominion Bldg., Secretary.

Dental Corps, U. S. Army, June 14-19.

Washington, D. C., Denver, Colo., San Francisco, Calif., and San Antonio, Texas. Adjutant General, U. S. Army, Washington, D. C.

ARIZONA STATE DENTAL SOCIETY

The next meeting of the Arizona State Dental Society will be held in Phoenix, April 23-24.

PAUL K. HILL, *Secretary,*
Consolidated Bank Bldg.,
Tucson.

OREGON STATE DENTAL ASSOCIATION

The next meeting of the Oregon State Dental Association will be held at Portland, June 23-25.

F. W. HOLLISTER, *Secretary,*
Selling Bldg.,
Portland.

VERMONT STATE DENTAL SOCIETY

The next meeting of the Vermont State Dental Society will be held at Burlington, May 19-20.

HOWARD H. REID, *Secretary,*
Barre.

NATIONAL BOARD OF DENTAL EXAMINERS

The National Board of Dental Examiners will hold an examination of candidates in Parts I and II, May 7-8, in such cities as five or more candidates shall request. For information and application blanks, address

MORTON J. LOEB, *Secretary,*
66 Trumbull St.,
New Haven, Conn.

CONNECTICUT DENTAL COMMISSION

The Connecticut Dental Commission will meet in Hartford, June 22-26, for the examination of applicants for license to practice dentistry and dental hygiene. Applications should be in the hands of the recorder at least ten days before the meeting. For application blanks and further information, address

ALMOND J. CUTTING, *Recorder,*
Southington.

DELAWARE STATE BOARD OF DENTAL EXAMINERS

The next meeting of the Delaware State Board of Dental Examiners will be held at Wilmington, July 7-9.

CHARLES R. JEFFERIS, *Secretary,*
409 Medical Arts Bldg.,
Wilmington.

LOUISIANA STATE BOARD OF DENTISTRY

The next examination of the Louisiana State Board of Dentistry for license to practice dentistry and dental hygiene will be held in New Orleans, June 14-18 at Loyola University. All credentials must be in the office of the secretary at least twenty days prior to the examination. Address all communications to

JOSEPH L. WEBRE, *Secretary,*
740 Audubon Bldg.,
New Orleans.

MISSISSIPPI STATE BOARD OF DENTAL EXAMINERS

The Mississippi State Board of Dental Examiners will hold its annual examinations for license to practice dentistry beginning June 15. Examination fee of $25 must be in the hands of the secretary by June 1. For application blank and instruction sheet, address

A. B. KELLY, *Secretary,*
Yazoo City.

MONTANA STATE BOARD OF DENTAL EXAMINERS

The Montana State Board of Dental Examiners will hold its annual examination for licenses to practice dentistry and dental hygiene at Helena, June 28-July 1. Applications must be in the office of the secretary at least twenty days prior to the examination.

LEONARD A. JENKIN, *Secretary,*
214 Medical Arts Bldg.,
Great Falls.

NEW MEXICO BOARD OF DENTAL EXAMINERS

The next meeting of the New Mexico Board of Dental Examiners will be held at

Clovis, June 16-18. All applications should be in the hands of the secretary at least ten days prior to June 16. For further information, address

J. J. CLARKE, *Secretary,*
Artesia.

NORTH DAKOTA STATE BOARD OF DENTAL EXAMINERS

The North Dakota State Board of Dental Examiners will hold its next examination at Fargo, July 12-15. All applications must be in the hands of the secretary at least ten days prior to the opening date. For further information, address

W. E. COLE, *Secretary,*
Bismarck.

PENNSYLVANIA STATE BOARD OF DENTAL EXAMINERS

The Pennsylvania State Board of Dental Examiners will hold its next examinations July 15-19 at Philadelphia and Pittsburgh.

W. A. MCCREADY, *Secretary,*
Highland Bldg.,
Pittsburgh.

SOUTH DAKOTA BOARD OF DENTAL EXAMINERS

The next examination of the South Dakota Board of Dental Examiners will be held in Sioux Falls, June 28-July 1. All applications must be in the hands of the secretary at least ten days before the date set for the examination. For further information, address

H. W. THOMAS, *Secretary,*
Aberdeen.

VERMONT BOARD OF DENTAL EXAMINERS

The Vermont State Board of Dental Examiners will meet June 28-30 at Montpelier to examine applicants for license to practice dentistry and dental hygiene. All applications, accompanied by the examination fee, must be in the hands of the secretary at least fifteen days before the date of examination. For applications and other information, address

H. B. SMALL, *Secretary,*
Burlington.

VIRGINIA STATE BOARD OF DENTAL EXAMINERS

The next regular meeting of the Virginia State Board of Dental Examiners will be held at the Medical College of Virginia, Richmond, beginning June 15. Applications, with fee and photograph, must be received fifteen days before the examination. For application blanks and further information, address

JOHN M. HUGHES, *Secretary,*
715 Medical Arts Bldg.,
Richmond.

WEST VIRGINIA STATE BOARD OF DENTAL EXAMINERS

The West Virginia State Board of Dental Examiners will conduct its next annual examination for license to practice dentistry in the State House, Charleston, June 28-30. All credentials must be in the office of the secretary at least thirty days before the examination. Address all requests for further information to

HENRY C. HILL, *Secretary,*
Dominion Bldg.,
Charleston.

WISCONSIN STATE BOARD OF DENTAL EXAMINERS

The next examination of the Wisconsin Board of Dental Examiners will be held at Marquette University, Milwaukee, June 21-25. Applications must be in the secretary's office ten days before the examination. For further information, address

S. F. DONOVAN, *Secretary,*
Tomah.

AMERICAN SOCIETY FOR THE PROMOTION OF DENTISTRY FOR CHILDREN

The next annual meeting of the American Society for the Promotion of Dentistry for Children will be held at the Hotel Chelsea in Atlantic City, July 12.

JOHN C. BRAUER, *Secretary,*
106 Forrest Ave., NE,
Atlanta, Ga.

ACADEMY OF ANESTHESIOLOGY IN ORAL SURGERY

The Academy of Anesthesiology in Oral Surgery will meet April 21 at the George Washington Hotel, New York City.

J. M. ESKOW, *Secretary,*
147 Market St.,
Perth Amboy, N. J.

NORTH ATLANTIC ORTHODONTIC SOCIETY

The semi-annual meeting of the North Atlantic Orthodontic Society will be held in the Hotel Pennsylvania, New York City, April 21, with sessions at 2 and 8 p.m.

EDWARD A. LUSTERMAN, *Secretary,*
185 West End Ave.,
Brooklyn, N. Y.

NEW YORK UNIVERSITY COLLEGE OF DENTISTRY POSTGRADUATE COURSE IN PERIODONTIA

The New York University College of Dentistry will hold its fourth annual postgraduate course in periodontia for two weeks, full day, or four weeks, mornings only; beginning June 21. The fee is $100 and the course is limited to fifteen. For information and application blank, address the Periodontia Department, New York University College of Dentistry, 209 E. 23d St., New York City.

LINCOLN HOSPITAL DENTAL STAFF

The dental staff of Lincoln Hospital will hold an open meeting at the hospital, April 8, at 8:30 p.m.

M. HILLEL FELDMAN,
730 Fifth Ave.,
New York City.

EUROPEAN ORTHODONTIC SOCIETY

The European Orthodontic Society will meet in Brussels, May 17-18, with headquarters at the Palace Hotel and sessions in the new Eastman Clinic.

G. F. CALE-MATTHEWS,
95 Newhall St.,
Birmingham, 3,
England.

RAILROAD FARES TO ATLANTIC CITY

Because of the reduced regular rates and round-trip fares, there is no longer any arrangement for convention rates and, therefore, there will be no convention certificates available as in the past. The new low rates for passage in pullmans and the lower rates for travel in coaches will be in force. Summer excursion rates will be available from some sections of the country. Inquire of your station agent as to the most economical fare.

AMERICAN DENTAL ASSOCIATION MEETING

Atlantic City, July 12 to 16, 1937

A SPECIAL INVITATION TO FRATERNITIES AND ASSOCIATED GROUPS

A MOST cordial invitation is extended to fraternities and associated groups to attend the 1937 meeting of the American Dental Association, in Atlantic City, July 12th to 16th. An unusual opportunity is offered these groups this year in the way of facilities and environment to stage meetings and reunions that will go far to solidify your ranks and advance the purposes of your organization.

Atlantic City is possessed of every qualification to make your meeting the most successful ever held. The hotels, as fine as any in the world, grouped within a convenient area along the Boardwalk and Atlantic Ocean, are all within walking distance of the great Convention Hall where the scientific program will be held.

Your fraternity has chosen for headquarters a hotel where you can be assured of ample conveniences for meetings, banquets and lounging rooms to enjoy the fraternalism available only at such a gathering. With the large number of hotels to accommodate the various groups, you will find an atmosphere nearing privacy at that hotel which will be devoted largely to the housing of your members.

You can, and should, arrange now to bring your wife and family, with a certainty that there will be endless entertainment, amusement, interest, education and sociability to satisfy every wish for an ideal vacation trip. You may be sure that right at your own hotel you will meet friends and associates with whom you have longed to exchange fraternal greetings.

Make your reservation now at your group headquarters hotel. The New Jersey State Dental Society is especially anxious to help make the group meetings successful.

We are anxious to welcome you to Atlantic City. Plan now to be with us!

LOCAL ARRANGEMENTS COMMITTEE,
W. A. WILSON, *Chairman of Publicity.*

AMERICAN DENTAL ASSOCIATION

Atlantic City, New Jersey — July 12-16, 1937

HOTEL RESERVATIONS

To secure hotel accommodations for the 1937 Session, consult the rate list below and fill out the attached blank. Mail this immediately to the hotel of your first choice or to the Housing Committee, Room 120, Hotel Ambassador, Atlantic City, N. J. Confirmation will be sent to you by the hotel.

Second and third choices of hotel should be indicated. If the reservation cannot be made at any of the hotels of your choice, the Housing Committee will place you in as favorable a hotel as possible and will notify you.

Please remember that a reservation constitutes a contract with the hotel to provide you with the accommodations you desire. If you find it impossible to carry out your part of the contract, namely, to occupy the room at the time agreed on, please write or wire the hotel releasing the room, in order that it may be available for other members.

APPLICATION FOR HOTEL ACCOMMODATIONS

AMERICAN DENTAL ASSOCIATION

Atlantic City, N. J. — July 12-16, 1937

HOTEL.....1st Choice

HOTEL.....2nd Choice

HOTEL.....3rd Choice

Kindly reserve the following:

.....Rooms with Bath for.....persons $.....per Room

.....Rooms without Bath for.....persons $.....per Room

Arriving on July.....at.....A. M.....P. M.

ROOMS TO BE OCCUPIED BY:

NAME	ADDRESS IN FULL

NOTE TO HOTEL NAMED AS FIRST CHOICE: If the hotel of first choice is unable to make the reservation requested, this application should be forwarded at once to the Housing Committee, Room 120, Ambassador Hotel, Atlantic City, N. J.

HOTELS	WITH BATH*		Additional Charge for Each Person for Three Meals
	One Person	Two Persons	
BOARDWALK HOTELS			
AMBASSADOR	$3.00–4.00–5.00–6.00	$6.00–7.00–8.00–10.00	$4.00
BRIGHTON	3.00–4.00–5.00	5.00–6.00–7.00–8.00	3.50
CHALFONTE-HADDON HALL	3.00–4.00–6.00–8.00	6.00–8.00–10.00–12.00	3.50
CHELSEA	3.00–4.00–5.00	5.00–6.00–7.00–8.00	3.00
CLARIDGE	4.00–5.00–6.00	6.00–7.00–8.00–11.00	4.00
DENNIS	3.50–4.00–5.00–6.00	6.00–7.00–8.00–9.00–10.00	3.00
KNICKERBOCKER	3.00–3.50–4.00	5.00–6.00–7.00–8.00–9.00	3.00
MARLBOROUGH-BLENHEIM	4.00–5.00–6.00	6.00–7.00–8.00–10.00–11.00	3.00
NEW BELMONT	2.50–3.00	4.00–5.00–6.00–8.00	†
RITZ-CARLTON	4.00–5.00	6.00–7.00–8.00	3.00
STRAND	3.50	6.00–7.00–9.00	3.00
SEASIDE		6.00–7.00–8.00	3.00
SHELBURNE	4.00–5.00	6.00–7.00–8.00	†
TRAYMORE	3.50–4.00–5.00	6.00–7.00–8.00	3.00
AVENUE HOTELS			
ARLINGTON		9.00—American plan only	2.00
COLTON MANOR	3.00–3.50–4.00	5.00–6.00–7.00	2.00
FLANDERS	2.50–3.00–4.00	4.00–5.00–6.00	2.00
FRANKLIN INN	3.00	4.00–5.00	2.00
GLASLYN-CHATHAM	Rooms with running water only		2.00
JEFFERSON	3.00–3.50	5.00–5.50–6.00	2.50
KENTUCKY	Rooms with running water only		†
LAFAYETTE	3.00–3.50–4.00	5.00–6.00–7.00	2.00
MADISON	3.00–3.50–4.00	5.00–6.00–7.00	2.50
MONTICELLO	Rooms with running water only		2.00
MORTON	4.50	7.00	2.50
PRINCESS	4.00	5.50–7.00	2.00
SENATOR		7.00	2.50
STERLING		5.00	2.00
THURBER	Rooms with running water only		†

*Rates on single and double rooms with running water available on request.
†European plan only.

OFFICERS AND TRUSTEES OF THE AMERICAN DENTAL ASSOCIATION
1936-1937

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